Poultry Management is part of the

AGRICULTURAL MANAGEMENT SERIES

prepared under the general supervision of R. W. Gregory

POULTRY MANAGEMENT

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Preface

MORE PERSONS are connected with the management of poultry than with any other kind of livestock. Poultry keepers are represented by specialists as well as novices and by large producers with thousands of birds on specialized or general farms as well as small producers with a few birds in the backyard. Poultry production is of interest to young and old and to persons in all walks of life.

To succeed it is necessary to know the principles of poultry management. It is a field of study which has broadened and which is constantly developing in many of its aspects. For that reason it is essential to keep abreast with the times in order to keep up *with the newest developments*.

Great strides have been made during the past two decades in the development of sound procedures in the industry. Scientific principles, based on adequate research, have eliminated much of the guesswork from our present day poultry practices. More exact information is available to poultrymen today on the nutritive requirements of chickens than is known in the case of any other farm animal or in the case of human nutrition. Much of the fundamental work in human nutrition had its basis in work with chickens.

Techniques in breeding have been improved and perfected to the point where production records, growth rates, and rates of feathering are being obtained far beyond those of twenty five years ago. The day of specialization in the poultry industry is now at hand. This is indicated by the fact that in certain varieties of chickens two distinct strains have been developed, one

for the production of broiler chicks and the other for replacement stock in laying flocks

Because of the broad interests and diverse backgrounds of the persons concerned it is not advisable in a general text to be too scientific, but yet the fundamentals must be presented This text attempts to meet the needs of the largest number of poultrymen It is intended primarily for the person who has some knowledge of the subject It is written to meet the needs of the vocational agricultural student, the average poultryman, the general farmer, the college student interested primarily in farm poultry, the high school student in general agriculture, and persons desiring a background in poultry

The authors have presented the information in a form which has been successfully used in teaching a beginning course in farm poultry This teaching experience has covered many years and has involved a large number of students

A list of selected references is given at the end of each chapter along with a number of questions It is hoped that the questions may be used by teachers in bringing some of the more practical applications of poultry management to the students

On page 557 will be found a list of state agricultural colleges This information given in a handy reference form will be most helpful to students

The authors wish to express their appreciation for the courtesies extended by various individuals and organizations in permitting the use of illustrations and tables Except where credit is indicated the illustrations originated at Cornell University

The authors also wish to acknowledge the help and inspiration of all those associated with them and those whom they have consulted

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POULTRY MANAGEMENT

CHAPTER 1

The Poultry Industry

SIZE AND IMPORTANCE

THE POULTRY industry ranks fourth as a source of income to the American farmer and is the first or second source of farm income in thirteen states In 1948 the gross value of poultry and poultry products was over three and a half billion dollars Poultry rates ahead of vegetables, wheat, cotton, fruits, corn, and similar major agricultural products It is found on more farms than any other type of livestock, and many farmers make their entire living from poultry and poultry products

The poultry industry is constantly changing The great commercial broiler industry has developed during the past fif teen years to the point where it supplies about one third of the poultry meat There is a trend toward specialization with many poultrymen specializing in hatching eggs for broiler pro duction and others raising broilers or roasters, but the majority of part and full time poultrymen are primarily interested in table egg production The turkey industry has also become more specialized, with large flocks of thousands of birds becoming relatively common

Over half of the poultry and eggs are produced in the Middle West, but the eastern areas are increasing in importance The East and West Coasts have a much higher percentage of commercial poultry farms than the rest of the country This is due in part to the availability of good markets and in part to the fact that some of the other branches of agriculture are not pos sible or are less profitable The nearness to market simplifies the marketing process and helps maintain quality Where the

average size of the flock is small, the cost of assembling eggs for marketing is high and preservation of quality more difficult

TABLE 1 PERCENTAGE OF ALL FARMS REPORTING EGG PRODUCTION AND PERCENTAGE DISTRIBUTION OF EGG PRODUCTION BY SIZE OF FLOCKS, BY REGIONS, AND FOR THE UNITED STATES, 1944

Region	Farms Reporting	Eggs Produced from Flocks Whose Size Is—				
		Under 50	50–99	100–199	200–399	Over 400
North Atlantic	66.2	7.0	6.1	10.0	14.9	61.3
East North Central	80.3	7.0	15.6	36.0	27.1	13.6
West North Central	85.6	3.6	9.9	33.5	40.6	11.5
South Atlantic	82.3	33.0	21.2	15.6	11.5	18.4
South Central	86.0	26.7	26.3	25.6	14.8	6.3
Western	69.5	12.4	9.9	11.1	10.3	54.9
United States	81.3	12.1	14.2	25.2	24.0	23.8

(U S Department of Agriculture)

TABLE 2 FARM PRODUCTION OF EGGS AND PERCENTAGE OF U S TOTAL, BY REGIONS AND FOR THE UNITED STATES, FOR SELECTED YEARS 1925–48

Region	1925–29 Average		1935–39 Average		1941–45 Average		1946		1947		1948	
	Billions	Per Cent	Billions	Per Cent	Billions	Per Cent	Billions	Per Cent	Billions	Per Cent	Billions	Per Cent
North Atlantic	4.6	12	5.6	15	7.9	15	8.6	15	9.1	16	9.1	16
East North Central	8.2	22	8.2	23	10.6	21	11.4	21	11.4	21	11.5	21
West North Central	10.4	28	8.9	24	15.0	29	16.9	30	16.6	30	16.5	30
South Atlantic	3.4	9	3.2	9	4.2	8	4.5	8	4.5	8	4.3	8
South Central	6.6	18	6.2	17	9.0	17	8.9	16	8.4	15	8.3	15
Western	4.3	11	4.3	12	5.2	10	5.3	10	5.3	10	5.5	10
United States	37.5	100	36.4	100	51.9	100	55.6	100	55.3	100	55.2	100

(U S Department of Agriculture)

Listed below, in order of production, are the ten highest egg producing states in 1925–29 and in 1950

	1925–29	*1950*
1	Missouri	Iowa
2	Iowa	Minnesota
3	Ohio	Pennsylvania
4	Illinois	Texas
5	Kansas	Missouri
6	Texas	Illinois
7	California	California
8	Pennsylvania	Ohio
9	Indiana	Wisconsin
10	New York	New York

The number of eggs produced has been increasing at a faster rate than the number of hens because egg production per hen has increased due to improved breeding and better nutrition and management. Per capita consumption in the United States of eggs has increased from 298 in the period 1935 to 1939 to 382 in 1949, of poultry meat, from 17.9 pounds to 25.5 and of turkeys, from 2.6 pounds to 4.2 pounds for the same years. These increases are greater than for any other food product.

The past history of the poultry industry indicates that it offers an opportunity to the individual interested in agriculture. In common with other fields, the returns vary from year to year and from decade to decade but it has been consistently one of the more profitable farm enterprises. The material that follows discusses the possibilities of commercial production of poultry as well as its production as a part time enterprise in connection with general farming.

TABLE 3. RANK OF STATES ACCORDING TO GROSS INCOME FROM POULTRY (EGGS, FARM-RAISED CHICKENS, BROILERS, AND TURKEYS) AS A PERCENTAGE OF GROSS FARM INCOME, 1945

RANK	STATE	PERCENTAGE	RANK	STATE	PERCENTAGE
1	Delaware	76.27	25	Wisconsin	12.79
2	New Hampshire	54.43	26	Arkansas	12.78
3	Massachusetts	37.06	27	Tennessee	12.64
4	Maryland	34.69	28	Illinois	11.50
5	New Jersey	34.45	29	Nebraska	11.25
6	Connecticut	33.81	30	Alabama	11.02
7	Rhode Island	32.84	31	Kansas	10.87
8	Pennsylvania	27.81	32	South Dakota	10.59
9	West Virginia	26.44	33	Kentucky	10.48
10	Utah	26.43	34	Washington	10.47
11	Virginia	20.28	35	South Carolina	9.92
12	New York	19.24	36	North Carolina	9.91
13	Minnesota	19.23	37	Mississippi	9.17
14	Maine	18.98	38	Colorado	9.07
15	Ohio	16.76	39	Louisiana	8.70
16	Michigan	16.17	40	California	8.69
17	Missouri	16.09	41	Nevada	7.81
18	Oregon	14.59	42	North Dakota	6.10
19	Indiana	14.49	43	Idaho	5.99
20	Vermont	13.56	44	Florida	5.37
21	Georgia	13.07	45	New Mexico	5.08
22	Oklahoma	12.95	46	Montana	5.07
23	Texas	12.94	47	Wyoming	5.05
24	Iowa	12.88	48	Arizona	3.85
				United States	13.86

TABLE 4 EGGS ANNUAL RATE OF LAY PER LAYER ON FARMS DURING THE YEAR,[1] BY REGIONS AND FOR THE UNITED STATES, FOR SELECTED YEARS 1925–48, AND THE PERCENTAGE 1948 IS OF 1925–29

REGION	1925 29 AVERAGE	1935 39 AVERAGE	1941–45 AVERAGE	1946	1947	1948	PERCENTAGE 1948 IS OF 1925 29
	Number	Number	Number	Number	Number	Number	
North Atlantic	131	153	170	181	182	183	140
East North Central	118	133	151	163	164	170	144
West North Central	110	121	145	160	162	167	152
South Atlantic	112	119	128	135	137	140	125
South Central	109	111	123	126	130	133	122
Western	140	150	157	164	170	176	126
United States	117	128	144	155	158	162	138

[1] Total production divided by the average number of layers on hand during the year
(U S Department of Agriculture)

THE PLACE OF THE POULTRY ENTERPRISE

The trend in poultry farming has been toward large specialized farms, particularly on the East and West Coasts Even in these areas, however, the majority of farms with poultry are still diversified, that is, they have one or more important enterprises in addition to the poultry enterprise

On part time farms The automobile and good roads have made it possible for many people who work in town to live in the country This gives them not only a satisfactory place to live but a chance to raise a portion of the family s food supply and to supplement the weekly paycheck from the sale of surplus farm products In short, part time farming is one way to use family labor to advantage Since the children, the wife, and the husband usually work at home in the evenings and over weekends a good enterprise for many is a small poultry flock

Some part time farms have as many as 500 and more laying hens Unless you have an unusual amount of family labor, 500 layers are so many that the wife would have to do much of the work and still are too few to justify the hiring of a full time man to care for the birds The investment in a small poultry flock is usually little, but a great deal of experience can be obtained in the science of raising poultry

TABLE 5 NUMBER OF HENS AND PULLETS ON HAND JANUARY 1, BY STATES, FOR SELECTED YEARS 1925–50

STATE	1925–29 AVERAGE	1935 39 AVERAGE	1941–45 AVERAGE	1946	1948	1950[†]
	Thousands	*Thousands*	*Thousands*	*Thousands*	*Thousands*	*Thousands*
Maine	1,757	1,616	2,416	2,566	2,455	2,901
New Hampshire	1,113	1,424	2,248	2,528	2,191	2,525
Vermont	876	740	1,052	1,143	968	1,039
Massachusetts	1,963	3,001	4,973	6,028	4,690	5,011
Rhode Island	334	331	551	629	543	581
Connecticut	1,670	2,117	3,206	3,648	3,264	3,370
New York	13,158	12,924	15,246	16,036	15,789	16,787
New Jersey	4,133	4,734	8,141	9,613	9,886	11,997
Pennsylvania	16,948	17,034	20,224	22,717	21,250	23,391
Ohio	20,970	19,506	20,852	19,855	18,294	18,731
Indiana	16,268	13,724	15,431	16,143	15,570	15,963
Illinois	24,365	20,342	23,057	23,443	21,139	21,901
Michigan	12,061	11,367	12,722	13,017	11,046	11,971
Wisconsin	13,512	14,324	16,915	17,989	17,047	17,180
Minnesota	16,249	16,640	26,025	29,446	27,605	27,783
Iowa	29,521	27,455	35,578	35,617	32,005	32,792
Missouri	27,578	19,333	24,294	24,416	21,512	22,786
North Dakota	4,766	3,357	5,582	5,666	4,731	4,613
South Dakota	8,079	5,647	9,126	9,349	8,845	8,663
Nebraska	12,692	10,953	15,442	15,638	13,876	13,499
Kansas	20,688	13,721	17,061	17,334	14,806	14,800
Delaware	1,371	926	1,052	1,112	979	965
Maryland	4,085	3,246	3,927	4,188	3,879	3,844
Virginia	8,964	8,282	9,621	10,187	9,157	9,318
West Virginia	4,178	3,860	4,348	4,233	3,664	3,991
North Carolina	8,240	7,811	9,891	10,531	8,998	9,460
South Carolina	3,823	3,201	4,208	4,657	3,862	3,817
Georgia	6,684	6,264	8,006	8,196	7,240	7,239
Florida	2,159	1,955	2,470	2,614	2,298	2,431
Kentucky	10,595	9,727	11,246	11,761	10,714	10,742
Tennessee	11,460	9,512	11,134	11,076	9,930	9,975
Alabama	6,350	6,231	7,789	7,875	6,644	6,814
Mississippi	6,294	6,283	7,644	7,331	6,343	6,474
Arkansas	7,431	7,007	8,598	8,007	6,600	6,810
Louisiana	3,868	3,731	4,964	4,757	3,799	3,884
Oklahoma	13,280	9,695	12,982	12,571	10,475	10,302
Texas	20,859	21,621	30,695	31,514	26,013	24,781
Montana	2,265	1,728	2,244	2,033	1,777	1,922
Idaho	2,218	2,015	2,533	2,347	2,095	2,112
Wyoming	755	663	839	812	766	769
Colorado	3,784	2,953	3,920	3,824	3,295	3,241
New Mexico	938	948	1,171	1,253	1,130	1,049
Arizona	664	570	664	639	649	627
Utah	1,662	2,161	2,770	3,033	2,886	3,266
Nevada	247	232	273	283	279	267
Washington	6,607	6,008	6,211	5,424	4,764	5,220
Oregon	3,162	3,155	3,604	3,642	3,149	3,250
California	15,387	14,302	16,184	17,512	17,568	21,314

[†] Preliminary report
(U S Department of Agriculture)

Successful experience in handling a small flock on a part time farm is not complete assurance that you can handle a much larger flock with the same degree of success The problems of managing a large flock as compared with a small flock tend to multiply

On general farms The type of a poultry enterprise for a general farm depends upon the purpose for which poultry is to be kept If your only purpose is to provide the family with poultry meat and eggs during the year then a flock of from 25 to 50 layers probably is large enough The job of caring for the flock is left to the wife or children In general only a minimum amount of care is needed or given to the birds

If the purpose of the poultry enterprise is to increase the size of the farm business you want to have enough layers to provide an efficient sized enterprise In general this means a flock of 500 or more layers A flock of this size adds materially to your income and will help to use labor throughout the day especially during the winter months when not much time is spent on other enterprises

On specialized farms Poultry is one of the best enterprises for a specialized farm Its advantages are these

1 The men are kept busy each day of the year

2 The income is distributed throughout the year On egg producing farms a weekly check is common

3 Poultry is one of the better paying farm enterprises

4 There are several different phases of poultry farming

The chief disadvantage is that poultry is a risky business A bad year for poultry is especially severe on specialized farms because usually there are no other sources of income It is the age-old problem of having all your eggs in one basket You must take good care of the basket

Although many poultrymen specialize in the production of eggs for market others engage in two or more phases of the poultry business For example some poultrymen are interested primarily in producing eggs for market but also produce eggs for hatching Some in addition to producing eggs for market are engaged in the business of hatching chicks While several of the phases of poultry farming combine well with each other others such as turkey growing and chicken production do not.

Your choice of the phases of the poultry business in which you should engage is pretty much a matter of using the facilities available and of making use of your ability and personal preference. In general, poultrymen work into the different phases over a period of years rather than start several at the same time

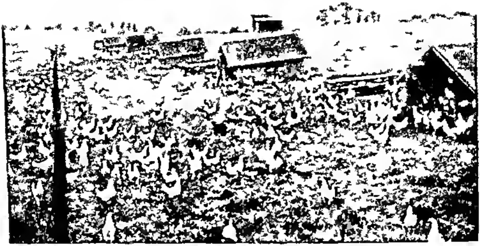
Market eggs. Most poultrymen produce eggs for sale to wholesale buyers. These poultrymen have found that they received more for their time by producing eggs than by marketing eggs. Some, of course, are not located conveniently near cities and thus find it more practical to sell the eggs on a wholesale basis.

U S D.A photograph by Forsythe

Bringing in the eggs on a Pennsylvania farm. The U. S. Department of Agriculture recommends this type of basket.

Other ways to market eggs are (1) to sell to retail stores, hotels, and restaurants; and (2) to sell direct to the consumer. In the first way, the producer grades and packs the eggs and delivers them to the buyer. The poultryman usually receives more for his eggs under this system of selling than by selling wholesale; the eggs must, however, be candled and graded, which takes more labor. If you have to have extra labor, there is the question of where it might best be used—in grading or in producing eggs.

Poultrymen who market eggs direct to the consumer generally are near a good market, and usually have small or moderate-sized flocks. This type of marketing, although it returns the highest price per dozen eggs, involves the additional expenses of candling, grading, cartoning, delivering, and collecting. All these extra costs should be taken into consideration in deciding whether you want to sell eggs at retail. You should remember that the larger your flock of hens, the more difficult it is to operate a retail egg business.



U S D.A photograph by Knell

Some of the 900 eight weeks-old white Leghorn pullets being raised on an open range

Hatching eggs The growth of large scale commercial chick hatcheries has created a demand for hatching eggs Many poultrymen who have good quality birds are already supplying eggs to hatcheries and are receiving a premium in addition to the market price for these eggs Against the prices received for hatching eggs one must place (1) the cost of keeping males (2) the feeding of a special breeding mash (3) blood testing of the flock (4) the sale of eggs not suited for hatching at market prices (5) special packing and delivery of eggs (6) the discard ing of birds not suitable for breeders and (7) to some extent the keeping of the old hens out of production during the high priced egg months in the fall just to get eggs in the spring the hatching season when prices are always low Some hatchery men pay part of the above costs In general to make a profit in this phase of the business poultrymen must sell eggs over a long period of time and get a good premium

Breeders Breeding is one of the most interesting phases of the poultry business but the most difficult The main objective of the breeder is to improve the egg laying and meat producing


Courtesy Future Farmers of America

Properly managed, turkeys can be profitable. The flock pictured above was developed by a Perry, Oklahoma, Future Farmers of America member from a few birds he raised as a vocational agricultural project. Close attention to the needs of the birds, with scientific feeding and management, enabled this young turkey farmer to build up a profitable business.

ability of the birds. Even on the most outstanding breeding farms, the primary source of income is usually the sale of baby chicks. It is definitely not for the beginner. It calls for more specialized ability with poultry, more investment, and more labor than any other type of poultry production. The business is highly competitive, and only the most successful receive a return in line with the efforts involved.

Hatcheries. The production of chicks by hatcheries that do not produce their own eggs has become widespread. The hatcheryman buys eggs from producers of hatching eggs, incubates them, and sells the chicks. It is often one of the most profitable phases of the poultry business. It is, however, one of the most difficult in which to become established because poultrymen like to buy chicks from proved stock.

Pullets. A few poultrymen specialize in the production of pullets for sale, either as partly grown or ready-to-lay birds. Many poultrymen, however, raise a few extra pullets to sell after

TABLE 6 NUMBER OF TURKEYS RAISED, BY STATES, FOR SELECTED YEARS 1929–1950

STATE	1929–33 AVERAGE	1935–39 AVERAGE	1941–45 AVERAGE	1946	1948	1950[1]
	Thousands	*Thousands*	*Thousands*	*Thousands*	*Thousands*	*Thousands*
Maine	31	43	50	51	37	45
New Hampshire	22	45	72	75	61	69
Vermont	33	96	149	174	100	121
Massachusetts	99	194	294	333	307	335
Rhode Island	17	22	28	33	31	34
Connecticut	42	84	156	212	178	206
New York	199	328	541	756	763	809
New Jersey	57	122	214	405	328	400
Pennsylvania	320	632	1,063	1,431	1,264	1,378
Ohio	353	674	939	1,155	1,031	1,186
Indiana	212	357	565	1,081	919	1,241
Illinois	141	400	713	1,152	1,016	1,118
Michigan	316	448	623	932	780	975
Wisconsin	272	344	534	614	442	606
Minnesota	1,616	2,216	3,283	4,019	2,759	3,669
Iowa	253	1,330	2,113	3,208	1,899	2,848
Missouri	369	1 065	1,521	1,746	1,310	1,572
North Dakota	1,687	1,369	970	926	500	775
South Dakota	638	840	720	421	206	281
Nebraska	325	640	930	970	716	931
Kansas	356	828	947	896	530	742
Delaware	83	113	95	91	61	70
Maryland	349	402	418	466	321	417
Virginia	596	730	957	1,331	1,221	1,526
West Virginia	222	235	309	437	498	682
North Carolina	236	234	283	421	360	486
South Carolina	117	143	254	420	446	714
Georgia	124	123	142	182	187	280
Florida	102	119	105	115	109	125
Kentucky	473	380	255	220	173	216
Tennessee	196	212	165	175	140	182
Alabama	189	139	158	151	122	146
Mississippi	130	117	119	85	76	95
Arkansas	84	100	136	129	70	165
Louisiana	49	64	52	48	46	58
Oklahoma	857	1,412	896	652	365	474
Texas	4,191	3,834	3,912	4,231	3,018	4,225
Montana	417	299	184	170	113	130
Idaho	411	247	313	239	134	268
Wyoming	249	251	167	156	118	124
Colorado	562	744	881	900	562	759
New Mexico	149	79	68	88	94	103
Arizona	104	88	84	87	50	60
Utah	291	587	1,470	1,332	1,049	1,752
Nevada	80	66	40	46	30	32
Washington	262	441	1,167	1,303	1,065	1,118
Oregon	657	1,306	2,250	2,049	1,639	1,593
California	1,406	2,464	4,266	4,610	4,706	6,824

[1] Preliminary report.
(U S Department of Agriculture)

they have filled their own laying houses, and a few produce pullets as a sideline. Because the production of pullets is highly seasonal, a pullet grower might well engage also in broiler production. Persons interested in a large-scale business of growing pullets for sale should not keep a laying flock, because contacts between pullets and old hens may cause heavy mortality when the pullets mature.

Turkeys. Turkey production has been increasing. The growing of turkeys, however, requires more skill than that required in growing chickens. The risks involved are greater, and the amount of investment required to produce turkeys is large. If you have had experience and have ability and capital, the turkey business has a future. Cost accounts indicate that the business can be profitable. Beginners had better start on a small scale. The turkey business and the chicken business do not go well together because turkeys are highly susceptible to several minor diseases of chickens.

TABLE 7 NUMBER AND PERCENTAGE OF TOTAL TURKEYS RAISED, BY REGIONS AND FOR THE UNITED STATES, FOR SELECTED YEARS 1929–48

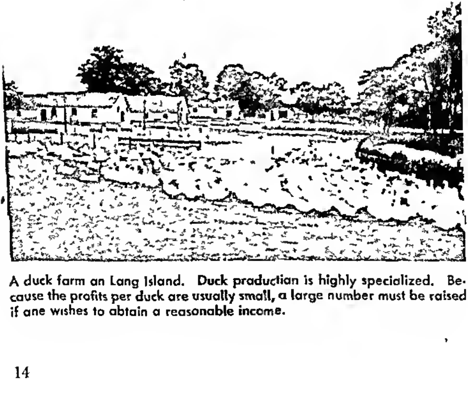
Region	1929–33 Average		1935–39 Average		1941–45 Average		1946		1947		1948	
	Millions	*Per Cent*	*Millions*	*Per Cent*	*Millions*	*Per Cent*	*Millions*	*Per Cent*	*Millions*	*Per Cent*	*Millions*	*Per Cent*
North Atlantic	0.8	4	1.6	6	2.6	7	3.5	9	3.2	9	3.1	10
East North Central	1.3	7	2.2	8	3.4	10	4.9	12	4.6	13	4.2	13
West North Central	5.2	26	8.3	31	10.4	29	12.2	30	10.1	29	7.9	25
South Atlantic	1.8	9	2.1	8	2.6	7	3.4	8	3.0	9	3.2	10
South Central	6.2	31	6.3	23	5.7	16	5.7	14	4.9	14	4.0	12
Western	4.6	23	6.5	24	10.9	31	11.0	27	9.2	26	9.6	30
United States	19.9	100	27.0	100	35.6	100	40.7	100	35.0	100	32.0	100

(U. S Department of Agriculture.)

Ducks. New York State, and particularly Suffolk County on Long Island, is the largest producer of ducks in the country, producing nearly 50 per cent of all ducks grown in the United States. Massachusetts and Michigan are also important producing areas, and there are a few areas elsewhere which produce large numbers. Duck production is a highly specialized business. The returns per duck are generally small, and a large number are needed to insure a reasonable income. Because

Courtesy U S Department of Agriculture

A view on a commerciol duck form on Long Island, New York.



A duck farm on Long Island. Duck production is highly specialized. Because the profits per duck are usually small, a large number must be raised if one wishes to obtain a reasonable income.

the margin of profit is usually small, it is often difficult for beginners to make a successful start in the business.

Broilers. Broiler production has increased rapidly during the past ten years. In the Del Mar Va area (parts of Delaware, Maryland, and Virginia) and a few other areas, the industry is highly specialized. Broiler men raise a large number of birds and buy all their chicks and feed. In other areas, broiler production is generally a sideline to poultry or other farm enterprises. Georgia, North Carolina, Arkansas, and many other states and areas are also developing a large broiler industry.

TABLE 8. Number of Commercial Broilers Produced, by Region and for the United States, for Selected Years 1935–48

Region	1935–39 Average		1941–45 Average		1946		1947		1948	
	Millions	Per Cent	Millions	Per Cent	Millions	Per Cent	Millions	Per Cent	Millions	Per Cent
North Atlantic	10	14	29	11	32	11	34	12	43	12
East North Central	8	12	22	8	22	8	22	7	26	8
West North Central....	2	3	7	3	7	3	7	2	12	3
South Atlantic	33	47	153	58	161	58	175	60	192	55
South Central	12	17	38	15	41	15	39	13	57	16
Western	5	7	14	5	13	5	18	6	21	6
United States	70	100	263	100	276	100	295	100	351	100

(U S Department of Agriculture)

Broilers are usually marketed when they weigh from 3 to 3½ pounds. This weight is usually attained at the age of from 10 to 12 weeks. On many farms the birds are kept to even heavier weights; the females are sold as pullets and the males as roasters. Some poultrymen produce 1½- to 2-pound broilers for special markets. In general, the broiler business is highly speculative and either the net returns can be high or the losses great.

Capons and roasters. Inexperienced poultrymen often believe that the production of capons and roasters offers easy income. Since feed and labor are the major costs involved in the production of these heavy birds, the producers in the low feed-cost areas have an advantage. Frequently the advantage of being near to market does offset the differences in feed and labor costs. The poultryman who has a good market and can

TABLE 9. NUMBER OF COMMERCIAL BROILERS PRODUCED, BY STATES, FOR SELECTED YEARS 1935–50

STATE	1935–39 AVERAGE	1941–45 AVERAGE	1946	1948	1950[1]
	Thousands	*Thousands*	*Thousands*	*Thousands*	*Thousands*
Maine	334	1,074	871	3,220	16,923
New Hampshire	799	2,441	2,245	3,321	4,821
Vermont	263	624	416	400	576
Massachusetts	1,456	4,120	4,464	6,374	9,322
Rhode Island	80	468	448	606	836
Connecticut	3,080	7,430	6,732	9,800	14,347
New York	1,870	5,400	6,394	6,794	9,784
New Jersey	773	3,098	3,990	4,176	6,163
Pennsylvania	1,850	4,674	5,902	7,903	13,562
Ohio	2,278	4,774	4,653	3,583	5,823
Indiana	2,320	5,474	6,704	9,503	27,902
Illinois	2,538	7,165	5,910	7,872	14,610
Michigan	470	1,140	1,104	1,104	2,180
Wisconsin	680	3,372	3,960	4,235	6,607
Minnesota	75	895	1,398	1,384	2,193
Iowa	300	2,970	2,805	4,018	6,007
Missouri	1,492	2,630	2,481	5,080	14,288
Nebraska					2,975
Kansas	634	934	757	1,034	2,094
Delaware	15,800	57,580	54,675	53,245	81,226
Maryland	4,520	30,980	31,122	38,233	54,437
Virginia	6,000	20,305	21,889	26,477	40,033
West Virginia	480	6,587	6,753	11,817	15,079
North Carolina	2,470	11,920	14,711	18,286	25,015
South Carolina	1,000	3,220	3,600	3,951	8,801
Georgia	1,060	17,304	22,435	33,025	62,892
Florida	1,320	5,090	5,462	7,276	9,036
Kentucky	500	1,136	1,211	1,090	1,908
Tennessee	1,300	1,880	1,800	2,596	4,205
Alabama	260	3,575	4,568	5,995	13,114
Mississippi	220	1,798	1,753	5,984	17,005
Arkansas	4,560	14,700	16,450	24,067	49,179
Louisiana	400	1,223	1,309	1,617	2,790
Oklahoma	1,340	960	800	1,056	2,909
Texas	3,300	12,392	12,474	14,208	33,383
Colorado					1,638
Arizona	154	613	517	729	1,048
Washington	566	1,948	1,792	3,756	5,860
Oregon	220	1,036	1,022	1,214	2,130
California	3,640	10,186	10,023	15,744	23,484

1 Preliminary report
(U S Department of Agriculture)

obtain a price that is well above the general market price may find this phase of the poultry business profitable.

The use of synthetic female hormones to obtain the same results as are obtained from caponizing is increasing in popularity. Diethylstilbestrol is the only product which is approved for this use at the present time. The practice is commonly called "chemical caponizing." Many broiler producers make a practice of treating all their birds three or four weeks before marketing. A complete discussion of this topic will be found on page 376, Chapter 11.

LONG-TIME POULTRY OUTLOOK

During World War II the poultry industry expanded greatly, and, although some reduction is in progress, the poultry population of the country is still in excess of that before the war. Following the period in which extra production is needed, a further decrease in the numbers of birds on farms may be expected. This type of adjustment usually follows a period of unsatisfactory profits and is likely to take place over a fairly short period of time.

Prospects beyond the readjustment period can best be determined by looking at the past. Over a period of many years, poultry has been one of the better paying farm enterprises. It is likely to continue so in the future.

One characteristic of poultry farming as compared with fruit or dairy farming is that an increase or a decrease in numbers can be brought about quickly. Thus in a period of high profits there will be a rapid increase in numbers, while in a period of low profits there will be a quick decline.

PROFITS TO BE EXPECTED

Poultry farming is a type of agriculture that provides satisfactory rewards for the men who do a high-grade job but severe penalties for those who do not. With careless methods of production, a dairyman can still produce a fair amount of milk and of feed crops; a careless poultryman is likely to be out of business within a short time.

The most widely used measure of profits on poultry farms is "labor income." This is what the poultryman has left for his year's work after he has paid all expenses and has deducted a

TABLE 10. Cost Account Records on New York Farm Flocks

Year	Total Number of Accounts	Average Size of Flock	Average Eggs per Hen	Average per Bird: Grain	Mash	Cost All Feed	Total Cost	Total Returns	Labor Returns	Labor
	Farms	*Birds*	*Eggs*	*Pounds*	*Pounds*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Hours*
1915–18	22	708	87	42	25	1.74	2.88	2.87	0.47	1.6
1919–23	29	491	99	47	25	1.91	3.38	4.09	1.34	1.7
1924–28	57	421	119	45	33	1.96	3.85	3.99	0.93	2.0
1929–33	144	679	135	44	39	1.59	3.55	3.46	0.55	1.8
1934–38	209	744	148	46	42	1.80	3.47	3.43	0.55	1.9
1939–43	185	863	161	34	43	2.11	3.77	4.41	1.27	1.7
1944–47	107	957	180	34	53	3.94	6.34	7.25	1.96	1.6

TABLE 11. Summary of Missouri Poultry Records of Farm Flocks, 1930–48

Year	Number of Flocks	Average Number Hens per Farm	Average Number Eggs per Hen	Income per Farm	Feed Cost per Farm	Income over Feed Cost per Farm	Income per Hen	Feed Cost per Hen	Income over Feed Cost per Hen
1930	370	173	145	$ 687.94	$ 352.26	$335.68	$3.98	$2.04	$1.94
1931	342	161	154	470.46	235.00	235.46	2.92	1.45	1.46
1932	334	157	147	355.52	153.05	202.47	2.26	.97	1.29
1933	363	162	143	349.81	162.29	187.52	1.72	.74	.98
1934	210	158	139	389.69	209.22	180.47	1.98	1.03	.93
1935	221	157	148	539.88	301.71	238.17	3.44	1.92	1.52
1936	512	149	137	446.91	252.50	194.41	3.09	1.67	1.31
1937	496	148	147	444.29	300.25	144.04	3.00	2.02	.98
1938	229	161	149	478.32	231.25	247.07	2.97	1.44	1.53
1939	175	169	154	473.78	240.93	232.85	2.80	1.42	1.38
1940	63	194	156	519.93	322.24	197.69	2.68	1.66	1.02
1941	48	185	167	676.73	345.39	331.34	3.66	1.87	1.79
1942	46	194	161	917.65	445.54	469.11	4.73	2.31	2.42
1943	45	196	164	1183.00	535.50	647.50	6.04	2.73	3.31
1944	34	185	168	1011.95	550.82	461.13	5.47	2.98	2.49
1945	90	180	178	1251.69	599.14	652.54	6.95	3.33	3.63
1946	70	178	169	1237.21	697.38	539.83	6.95	3.92	3.03
1947	78	207	190	1734.80	1046.67	688.13	8.38	5.06	3.32
1948	302	172	184	1539.06	1053.37	485.69	8.94	6.12	2.82

charge for the use of the capital invested in the farm. In addition to labor income, a poultryman has a house in which to live, a garden, milk, eggs, poultry meat, and other products.

The information in the following paragraphs is from a few successful poultrymen. Unsuccessful poultrymen are not poultrymen long.

In 1941, a good year for poultrymen but not so good as the years 1942 to 1949, the average labor income on 120 commercial poultry farms in New York State was $1,600. The number of hens averaged about 1,200 to the farm. Even though one out of every seven farms made more than a $3,000 labor income, one

out of every five made less than $500 In 1933, a very poor year, the average labor income on 122 commercial poultry farms in the same state was $530 The labor income on 65 of these farms was less than $500 Only seven farms had a labor income of more than $2,000

The labor income for commercial poultry farms with approximately 1,200 layers has averaged about $1,300 over a period of years

Based on these figures, you should remember—

1 That labor incomes vary considerably from year to year

2 That labor incomes vary considerably from farm to farm in any one year

3 That good poultrymen usually make an income which is above average each year

4 That many experienced poultrymen fail to make more than $500 annually

5 That poor poultrymen either improve quickly or else

It is probable that the 1941 figures more nearly reflect the average of a period of years than those of the 1942 to 1949 period, which was better than can usually be expected

WHY ALL POULTRYMEN MAKE MORE MONEY SOME YEARS THAN OTHER YEARS

The two important reasons why incomes of poultrymen vary so much from year to year are the general price level and the relationship between egg prices and feed prices Neither can be controlled by an individual poultryman

Level of prices The general level of all prices is the most important factor affecting profits in poultry farming It explains why the average labor income was only $530 in 1933, but was $1 600 in 1941

The relationship between level of prices and labor income can be stated in general the higher the prices, the higher the poultryman s labor income

Relationship between egg prices and feed prices Feed makes up one half of the cost of producing eggs and poultry meat Therefore, the relationship between the price of eggs and the price of feed is very important When the price of eggs is high in relation to the price of feed, conditions are favorable for egg production When the price of eggs is low in relation to the

price of feed, conditions are unfavorable. The factors that cause egg prices to be high or low in relation to feed prices are beyond the control of the individual poultryman

WHY SOME POULTRYMEN MAKE MORE MONEY THAN OTHERS IN ANY ONE YEAR

There are several reasons why some poultrymen make more money than others in any one year All of them are more or less under the control of the individual poultryman The five most important ones are (1) number of layers, (2) eggs produced per layer, (3) layers cared for per man, (4) deaths, and (5) eggs produced in the fall

Number of layers. Poultry farm business records have shown time and time again that as the number of layers kept per farm increased, the labor income increased

If you plan to specialize in the poultry business, you should have at least 1,500 hens per man working on the farm, and preferably more The estimate would include the time needed for rearing young stock, cleaning and packing eggs and doing the other chores necessary on any farm

If you wish to obtain most of your income from a job in town but also wish to keep some chickens as an additional source of income, you should be careful not to keep so many hens that they will burden the family with farm work

If you plan to operate a full time farm on which poultry is an important but not the major source of income, you should have a large flock, because a small flock is inefficient An efficient sized enterprise for such a farm would be 500 or more hens

Eggs produced per layer The number of eggs produced per layer affects the incomes of poultrymen Here is a general rule The higher the number of eggs produced per layer, the lower the cost of producing eggs and the higher the labor income of the poultryman Old timers in the egg business know this rule in the form of a saying that goes like this The hens that lay are the ones that pay, all the rest are roosters A 1941 study showed that the poultry farms with the highest production per hen (average 194 eggs) had a $620 larger labor income than those with the lowest production per hen (average 145 eggs)

The chicks offered for sale by reliable hatcheries are bred to produce a large number of eggs. The never ending job then is to so manage the chicks, and later the layers, that you can obtain the most eggs from each. Birds that lay more than 300 eggs a year are widely publicized, but there are few such birds. The most successful poultrymen get about 200 eggs per layer during the year, which is about three dozen above the average for commercial poultrymen.

Layers cared for per man. Since labor is the second biggest cost item on a poultry farm, it is important that it be used efficiently.

With the cost of labor higher than it has ever been and the prospects that it will continue high, there is an even more important reason why labor should be used efficiently. Work routine and buildings should be planned so that each person working on a specialized poultry farm takes care of from 1,500 to 2,000 layers for the year and raises the necessary number of pullets for flock replacement. This figure is constantly being increased on the more efficient farms. On general farms, the number of layers per man will fall below that on specialized farms because of other enterprises. An efficient sized poultry enterprise for a general farm, however, should have at least 500 layers.

A good sized business, well planned buildings and equipment, and a careful planning of work all go to increase the amount of work that can be accomplished per man.

Deaths. Deaths have always been a problem for poultrymen. The experienced and the inexperienced are continuously fighting to ward off diseases and to keep the number of deaths low. Yet an average of 12 per cent of all chicks die before they reach maturity, and more than 20 per cent of the hens die during the first year. In 1943 the death loss of layers on farms that kept accurate records ranged from a low of 10 out of each 100 layers to a high of 59 out of each 100.

Studies of commercial poultry farms show that the farms with a low number of deaths produced eggs at lower cost and had a higher labor income than did farms with a high number of deaths.

Sick hens do not lay eggs. Since medication is seldom effective, the hens lose weight and die quickly. When the death

Courtesy U S D A Extension Service photo by G W Ackerman

Quality poultry products pays dividends

rate gets out of control, and it often does, the poultryman is left with last month's feed bill and a lot of dead hens—a sure way to get out of the chicken business

Fall eggs. The number of eggs produced in the fall influences the average price received for the eggs and thereby affects labor income, the other factors affect incomes by reducing costs

Total egg production in the country varies from month to month in a regular pattern It is highest in April and lowest in November Between April and November, production declines each month Between November and April production increases each month

Egg prices, on the other hand, move opposite to production When production is at a peak, prices are lowest, when production is lowest, prices are highest

Egg prices during the last half of the year are higher than those during the first half Therefore, you should plan your business so as to produce a large quantity of eggs during the summer and fall months This will increase the average price received for eggs and thus affect your labor income

SOME SUCCESSFUL FARMS

You would not think of buying your first car or radio without shopping to find what the cars and radios look like Neither should you buy a farm unless you know something about farms Since it is not practical for all of you to "shop around" and find what successful farms look like, the farm organization, the investment, and the marketing practices of a few successful farms in New York State are described briefly in the following paragraphs

Part-time farms. *Farm A* This farm of 55 acres of land is about 12 miles from town The owner is occupied full time as an agricultural leader and commutes to his work.

The farm is valued at $6,500 Of this amount, $5,500 is invested in real estate and the rest in livestock and equipment

The owner keeps an average of about 100 layers, and raises 75 pullets each year Other livestock kept include 1 horse, 2 cows, and 3 sheep Most of the farm land is rented to neighboring farmers Six acres of hay and about 1 acre of corn are raised each year as feed for the livestock The owner does about one half of the work and his sons do the other half

Eggs are sold at retail to private customers in the city Poultry is dressed on the farm and sold there

Farm B This farm of 9 acres is just on the edge of a small town The owner is employed full time as the operator of the local milk plant

The farm is valued at $5,500 Of this amount, $4,350 is invested in real estate and $1,150 in livestock and equipment

The poultry enterprise averages about 450 layers for the year About 500 pullets are raised each summer No other livestock is kept Usually about 4 acres of grain and hay are raised and sold each year The owner does about 15 per cent of the work, his wife and mother, 75 per cent, and extra help, 10 per cent

Eggs are sold twice each week to a wholesale egg buyer in New York City The poultry is sold alive at the farm

General farms *Farm A* This farm of about 80 acres is valued at $20,600, of which $12,400 is in real estate and $8,200 in livestock and equipment

The number of hens averages about 1,100 during the year Approximately 825 pullets are raised each summer Other livestock include 16 milk cows, 10 heifers, 1 bull, and 2 horses The crops grown are corn silage, 28 acres, and alfalfa hay, 14 acres Both the silage and hay are fed to the milk cows No cash crops are grown

To do the work on this farm requires the full time of the owner and about seven months of hired help

Eggs are sold twice each week to a wholesale egg buyer Poultry is sold alive at the farm Milk is sold wholesale to a local milk plant

Farm B This farm is 155 acres in size The investment amounts to slightly more than $30 700 Of this amount $20,-700 is in real estate and $10 000 is in livestock and equipment

The poultry business consists of keeping an average of 825 laying hens for the year and raising about 650 pullets Other livestock include 15 milk cows 14 heifers 1 bull, and 3 horses The crops grown for feed are corn, wheat, oats, and barley, and alfalfa and clover hay Crops grown for sale are cabbage dry beans and potatoes

To do the work on this farm requires two men full time for the year and about 22 months of help during the growing and harvesting seasons

Eggs are sold twice each week to a wholesale egg buyer Poultry is sold alive at the farm Milk is sold wholesale to a local milk plant Cash crops are generally sold to local buyers

Farm C This farm of about 200 acres is in an important fruit area Of the $36 000 investment about $19 500 is in real estate and the rest is in livestock and equipment

The laying flock averages about 2 900 hens Approximately 2 300 pullets are raised each year Other important enter prises are hay 30 acres corn for grain 10 acres oats, 5 acres, apples 17 acres and other fruit, 2 acres

To do the work on this farm requires two men full time for the year and about 20 months of extra help during the growing and harvesting seasons

Eggs are sold mostly to a wholesale egg buyer A small proportion of the eggs practically all of the poultry, and a few apples are sold at retail in a nearby city The rest of the apples are sold wholesale at the farm

Poultry farms *Farm A* This farm of 21 acres specializes in the production of eggs The money invested in the business amounts to about $18 000 of which $13,700 is in real estate and $4 300 is in livestock and equipment

The number of hens averages about 2 000 About 3 000 pullets are raised each year One half of these pullets are raised in the spring and the other half in the fall

The work is performed by the operator and one other full time man

Eggs are sold twice each week to a wholesale egg buyer Poul try is sold alive at the farm

Farm B This farm consists of 10 acres of land The operator specializes in egg production The capital invested amounts to about $11 600 Real estate accounts for about $8,700 of this amount and livestock and equipment for the rest

The business consists of keeping an average of 1,600 laying hens and raising about 1 400 pullets

All the work is done by the operator

Eggs are sold twice each week to a wholesale egg buyer Poultry is sold alive at the farm

Farm C This farm of 18 acres also is devoted to the production of eggs The money invested amounts to about $14,500, of which $12 300 is in real estate and $2 200 is in livestock and equipment

The number of hens on this farm averages about 1 050 The number of pullets raised each year averages 870

The operator does all the work except for some day help which is used in cleaning the laying houses

Eggs are sold wholesale to a buyer who picks them up at the farm Poultry is dressed and sold wholesale in the same manner

Farm D This farm consists of 14 acres and is a poultry breeding farm The capital investment amounts to about $31,800, of which $21 500 is in real estate and $10 300 is in livestock and equipment

About one half of the laying flock which averages about 1 700 birds are breeding hens An average of 71 males are kept for breeding purposes About 2 200 pullets are raised each summer One half of these are kept on the farm for flock replacement while the other half are sold for laying purposes The number of chicks sold averages about 35 000 One cow is kept for home use

To do the work on this poultry breeding farm requires three men full time for the year and about nine months of extra help during the rush of the hatching season

About two thirds of the eggs are shipped to private customers The rest are sold at the farm Poultry is sold alive at the farm

PERSONAL REQUIREMENTS OF A POULTRYMAN

Poultry farming is more than just selling eggs and poultry meat A specialized poultry farm is a year round business

The same is true of the part time poultry enterprise Some of the jobs you need to do are as follows

1 Buy and raise the right kind of chicks at the right time
2 Get the chicks and hens to eat the right kind and amount of feed
3 Prevent poultry diseases
4 Keep the poultry house clean well ventilated and dry
5 Clean and pack eggs for market
6 Be on the job 7 days a week 365 days a year

Thus if you choose to be a poultryman you must be a laborer businessman mechanic veterinarian scientist and naturalist At least a dozen sciences are involved It is not enough that the jobs be done they must be done right and at the right time

Although modern machinery and automatic equipment have made poultry farming easier work than formerly there is still plenty of work to do Feed and too often water must be carried to the hens and young stock The litter on the floors must be removed and the dropping boards or pits cleaned regularly This means that the poultryman and his wife should be of good health and strength and like farm life and poultry

Gone are the days when a farm provided most of the family s necessities and there was little left over for the farmer to sell to others Successful poultrymen now find it most profitable to sell practically all that they produce and to buy most of the things the family needs In other words the opportunity of improving one s standard of living has changed from running the spinning wheel faster and longer to producing and selling more eggs and poultry meat This does not deny the desirability of raising a garden or of keeping a milk cow or two for home use A poultry farm is a business—an egg or meat factory —and sound business principles must be followed at all times

The ability to repair and adjust machinery and equipment is important if you wish to avoid costly and untimely delays in doing chores and other work If you can recognize diseased birds quickly and do something for them you can usually prevent the infection or trouble from spreading throughout the

flock, reducing egg production, and killing many birds Successful feeding and breeding will depend upon your knowledge of animal nutrition and the laws of heredity

Successful poultrymen have a characteristic that is often called 'chicken sense —in other words, the ability to keep the hens comfortable and eating lots of feed at all times To offset anything that might develop, a good poultryman always has "an ace up his sleeve For example, when egg production begins to drop, he turns on the lights to stimulate the hens, or he begins to feed wet mash or to stir the mash in the feed hoppers at intervals to encourage the hens to eat

PREPARING TO BECOME A POULTRYMAN

The poultry business has the reputation of being one of the quickest farm businesses to get into and one of the quickest to get out of, willingly or unwillingly

In addition to the cost of getting the land buildings, equipment, birds, and feed, there is often the important cost of learning the business or the art of not making any serious mistakes in management This cost can change overnight a paying business into a financial headache Thus it is important in preparing yourself for the poultry business to consider both experience and education Although both are important, neither guarantees success

Experience Experience is most important You would not think of becoming a banker or a merchant without first having obtained some experience in banking or in working in a store Likewise, you should not enter the poultry business without having first obtained some actual experience on one or more successful poultry farms This experience should include all the work on a poultry farm during the year, not merely that of gathering eggs in the summertime The managing of a laying flock during the warm summer months is quite different from that during the winter months when zero weather and frozen water pipes are common

The best way to have obtained experience is to have been born and reared on a poultry farm If you have not been so reared the best way to obtain this needed experience is to work for a year or more for a successful poultryman—to get the expert guidance of one who knows the poultry business The

cost of learning becomes a joint responsibility, not yours alone. Not only do you learn to do things, but often you learn how not to do some things. Also you have a chance to increase the amount of money you have saved to invest in a farm. If you are engaged in general farming, a small poultry project can be started and added to as you gain experience.

Education. Experience cannot be substituted for education, nor can education be substituted for experience. The need for an education has increased rapidly during the past few years and probably will continue to increase as poultry farming becomes more and more of a science.

If you have not had an agricultural education either in high school or in college, you should consider taking a course at some state agricultural school or state agricultural college. If you are unable to attend either of these, you might well study at home through the correspondence study courses that are available from many of the state agricultural colleges, and enroll in agriculture evening-school courses made available by your local departments of vocational agriculture in your high schools.

An education costs money and time, but it is yours for "keeps." Farm-business records have always shown that education paid, and chances are good that it will pay higher dividends in the future than in the past. For the poultryman to remain successful the process must be continuing.

GETTING STARTED IN THE POULTRY BUSINESS

Cost of a poultry farm. In New York State specialized poultry farms (fully equipped) of about 1,500 layers required an investment of approximately $15,000 in 1941. Of this amount, about $10,000 was in real estate, that is, the land and buildings, and $5,000 was in poultry, poultry equipment, and supplies.

Diversified poultry farms with about 1,200 layers, a small dairy herd, cropland, and the necessary buildings meant an investment of nearly $17,000 in 1941. About $11,000 of this amount was in real estate and the rest was in poultry, other livestock, equipment, and supplies. Since 1941, however, values have risen sharply and present investments are well above those for the pre-World War II years. Data from other states are comparable to these figures.

In any event, a lot of money is needed to buy a good farm Poor farms, which can be obtained for less, are more difficult to pay for because they are far less productive than the good farms In general, good farms sell for less than they are worth, poor farms sell for more

It is cheaper to buy a farm with good buildings than to buy one with such poor buildings that either many repairs need to be made or new buildings need to be built The same general rule applies in buying a farm with electricity, a water system, and other modern improvements, because costs were much lower a few years ago than now

New, practical poultry buildings normally can be constructed at a cost of about $3 00 to $5 00 a hen A good barn can be changed into a good hen house at a cost of from $1 00 to $2 50 a hen

Selecting the area Part time and commercial poultry farming are practical and possible anywhere in the United States Although commercial farms are more common in the East and West Coast areas, they are increasing rapidly in other areas Cost account studies do not show a great deal of difference in labor income among the different sections of the country The area to choose depends mostly upon what climate you prefer, the markets available, and the type of community in which you want to live While many portions of the Middle West produce a surplus of poultry and eggs there is a good demand for above average quality products right at home awaiting to be satisfied This has been demonstrated during the past few years by the development of the commercial broiler industry in the Middle West even in areas where surplus ordinary quality farm poultry is available

Selecting the poultry farm The most important things to consider in selecting a farm within any area are soil, topography, buildings, layout roads schools water system, and electricity

Specialized poultrymen can to some extent overlook soil and topography because feed can be purchased and only about one acre of well drained fertile land is needed for each 500 pullets raised during the summer Unlike other farm enterprises, income from poultry farming depends less upon soil and weather and more upon those things that are within the control of the poultryman As mentioned before, it is cheaper to buy a farm

with good buildings electricity water system and other modern improvements than to buy a farm with poor buildings and no modern improvements

Choose a farm on a road that is usable the entire year The farm should be near a feed store and on an egg truck route or near a shipping point because feed must be purchased often and poultrymen on back roads find it difficult to market eggs and poultry meat regularly during the winter when many roads are blocked by snow In general farms on good roads cost more to buy than do those on other roads but the advantages of being on a hard surfaced road generally more than offset the additional cost involved

You should never buy an abandoned farm Even though the productiveness of the soil can largely be forgotten you cannot afford to overlook the good roads that are kept open throughout the year the availability of telephone and electric service neighbors and nearness to good schools

It is best to examine several farms before deciding which one to buy If possible see the farm during each season of the year Most farms look good in winter when the ground is covered with snow and in spring when everything is green and flowering but they may look quite different in summer after a drought and at harvest time Usually you need to consider more than the paint to value a farm correctly

Becoming an owner The one thing you should have in mind in becoming an owner is the amount of capital usually invested in a commercial poultry farm A study of many such farms in 1941 showed that the usual poultry farm of from 1 200 to 1 500 hens had an average investment of about $15 000 Two thirds of this amount or $10 000 was for land poultry buildings operator s house and other buildings while the rest was for poultry equipment other livestock and feed and supplies on hand

Few start poultry farming on a large scale The general practice is to begin with a few hundred layers and gradually build up to the maximum number Thus less capital is needed to start poultry farming than the average investment for going farms would indicate (Table 12)

How much money do you need? The amount of money you need to buy a farm and to get started in poultry farming de-

TABLE 12. CAPITAL INVESTMENT FOR COMMERCIAL POULTRY FARMS, 1941

ITEM	INVESTMENT
Land and buildings	$10,000
Poultry equipment	700
Other equipment, such as farm truck, automobile, and miscellaneous tools	1,000
Poultry (laying hens, pullets, and others)	2,700
Other livestock such as a cow or two, a pig, and a horse or two on some farms	300
Feed and supplies on hand	300
Total	$15,000

pends upon your experience, the size and condition of the farm; the location of the farm; your reputation in the community; and the schools, roads, electricity, and other conveniences Some general rules are as follows:

1. *If you have had little or no practical experience with poultry, you should plan to get it before you buy a farm.*

2. *If you have had a great deal of practical experience with poultry, you should have enough money of your own to—*

a. Pay at least from one third to one-half the purchase price of the land and buildings.

b. Buy the necessary equipment, put the laying house in shape for use, buy chicks and raise them until they are from six to eight months of age, and pay living expenses for yourself and family during this period.

Some costs have been determined: To raise pullets to maturity in normal times costs about $2.00 each. Equipment for hens and pullets costs about $1.00 for each bird to be kept. No general statement can be given for the costs of living, the costs of other equipment, or of the amount needed to put the laying house in shape, as they depend too much on individual situations.

You should have more money than is actually needed to buy and run the farm for a few months The poultry enterprise is risky and you may need a margin of safety should the first year be a bad one. Poor years are common even to experienced poultrymen.

A person with a limited amount of money should never buy a large equity in a poor farm It is much better to buy a small equity in a good farm

How to get money The big problem then in becoming an owner is to get enough capital The ways to accumulate capital and become an owner are through (1) the inheritance or gift route (2) the home farm route (3) the salaried job route and (4) the hired man–tenant route

The inheritance or gift route is available only to a few persons The difficulty with inheritance or a gift is that you seldom know when it will be available

The home farm route means gradually working into the business and then buying the farm An important consideration is whether the farm business is good enough and big enough to support all the persons who would get their income from it If you plan to use the home farm route do so on a business like basis

Advantages of the home farm route are that (1) you know the farm (2) you have friends in the neighborhood and (3) you can profit by your father s judgment and experience

The salaried job route is often used by persons who want to save money to buy a farm The usual policy is to get a job that deals with agriculture and after a few years buy a farm If you do this you may want to give up the job but by continuing with the job you can save more money for the farm and get a good farm business started earlier

The advantages of this route are that it (1) gives you experience in another line of work and (2) enables you to observe more different farm businesses You may be trained away from as well as into agriculture A disadvantage commonly associated with this route is that you get the spending rather than the saving habit

The hired man–tenant route is perhaps the route most often used by young persons interested in becoming farmers Briefly it involves working on a farm as a hired man saving money and gaining experience then renting a farm saving money and gaining experience and then buying a farm The opportunity to follow this route is good because there is always a need for capable hired men and tenants By this method you gain the

confidence of others in the community, which in turn will make it easier for you to obtain financial backing when you are ready to buy a farm

The chief drawback is the tendency to buy a farm too soon and, by so doing, get too small or too poor a farm Records show that a person with a limited amount of money can operate a larger farm business and make a larger income for himself as a tenant than as an owner

Financing the farm Becoming an owner generally means financing the purchase of the farm The most common way to do this is to get a first mortgage loan from the Federal Land Bank, a local bank, or some other conservative lender, and a second mortgage loan, if necessary, from the person who sold you the farm or from another individual In this method of financing, the individual must have complete confidence in your ability to succeed

Records to keep Successful poultrymen have found that a good set of records is a ' must " A poultry farm without records is like an automobile without an instrument panel You can't tell how far you ve gone or how fast you re traveling (profits), whether the gasoline (egg production) is low, whether the battery is being charged (capital accumulated), and many other things that go to make a farm business click "

Farm records may be used to—

1 Record events and show when bills were paid and money received

2 File an accurate income tax return

3 Study the farm business from the point of view of finding the good points and the points that need to be improved

4 Share profits on partnership farms

You should keep three different kinds of records They are a farm inventory, a cash account, and a production record

A farm inventory is a list of all that a farmer owns and owes at a given time The value of each item is listed also The best date to take an inventory is usually January 1

A cash account is a daily listing of all farm expenses and receipts The method of keeping a cash account depends upon the type of cash account book you have and what you want it to show

A production record is a daily record that shows how many eggs were produced and how many hens died or were culled The best way to keep this type of record is to tack a special record sheet to the hen house door and to make the entries as you leave the hen house At the same time you can compare the day s production with that for the previous days to see whether the hens are increasing decreasing or producing about the same

The breed A question that every poultryman must answer is What is the best breed of chickens to raise? The answer is that there is no one best breed if the selection is made from a good strain of one of the most important breeds

Your choice will depend upon egg and poultry prices the type of specialization desired the market available and perhaps personal preference Leghorns which lay white eggs are most popular on market egg farms in New York and New Jersey because white eggs are preferred by the New York markets The heavy breeds and crosses which lay brown eggs are general purpose fowls that are kept for both egg and meat production New England markets prefer brown eggs and as a result most of the market egg farms in that area have heavy breeds These marked preferences do not hold in other areas

In 1940 to 1941 when the rate of egg production was high (about 200 eggs a layer) heavy breeds produced eggs as economically and gave about as high a return for labor on the laying flock as did the light breed flocks With a low or with an average rate of egg production the light breed flocks produce eggs more economically and give a higher return for labor than do the heavy breed flocks

In 1946 to 1947 light and heavy breed flocks of similar size and rates of lay had about the same cost per dozen eggs Because of the difference in prices of brown and white eggs however the returns and profits were greater for the light breeds

The question of which breed to raise is one for the individual poultryman to answer Chief attention should be given to egg prices but facilities equipment and management need to be considered The New York markets usually pay premiums for white eggs but this is not true in many other places

Rock–Hampshire crosses and New Hampshires are the most popular in the Eastern areas for broiler production although

other crosses are increasing in popularity, particularly in the midwestern areas

SUGGESTIONS AND QUESTIONS

1 Write to your state agricultural college for cost account studies on poultry production in your own state The extension service can also furnish bulletins on poultry covering the phases of the business in which you are most interested A list of available publications can be obtained by writing for it

2 The Office of Information, United States Department of Agriculture, Washington, D C, can furnish bulletins and statistical material dealing with the poultry industry Write for a list of available publications

3 Attend national state or local poultry meetings whenever possible

4 Subscribe to and read poultry journals

5 Start a home poultry library

6 Keep a scrapbook of poultry pictures and articles of interest

7 Visit colleges, demonstration farms, egg laying tests, and research laboratories to observe poultry practices and obtain information

8 Become a member of poultry organizations and enter into their activities

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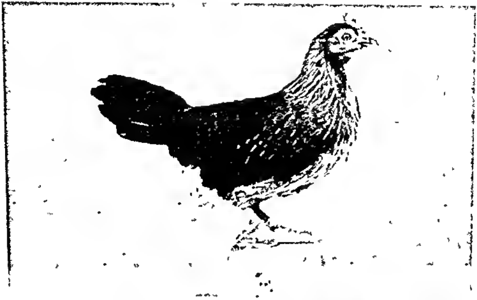
CHAPTER 2

Breeds of Poultry: Their Nature, Characteristics, and Uses

EARLY HISTORY

THE MOST COMMON belief among poultrymen and scientists today in regard to the origin of the chicken is that most, if not all, of the breeds and varieties have descended from one or possibly four subspecies of wild fowl Beebe (1926) states that, "Of all the pheasants (the chicken belongs to the pheasant family), indeed, of all the birds in the world, the red jungle fowl stands first in importance to mankind on the earth From this species, and this alone, all the forms of domestic fowls have taken their origin, and hence from this relation to man of economic utility this bird assumes a position of great interest" Darwin also believed that all chickens had a common origin Some scientists are not in accord with this belief

Certainly for more than 5,000 years the domesticated fowl has been closely associated with the gradual development of an adequate agriculture in many parts of the world, and under some circumstances has been the only animal which could be kept for the production of human food The red jungle fowl illustrated on page 38 may still be found in large numbers in its native habitat, among the bamboo jungles of India, Thailand, and the Malay Peninsula to Sumatra It has also been introduced in many other islands of the East Indies The domesticated strains have been introduced into many countries where these birds have been used by animal breeders in experimental work Much has been learned relative to the inheritance of plumage



Courtesy Dr. F B Hutt

The red jungle fowl. The female is shown in the top picture, the male in the bottom picture.

color variations and structural features which characterize our modern birds and which differ so markedly from the characters possessed by the red jungle fowl.

There is no doubt that the sport of cockfighting played a tremendous part in the domestication and later development of

our modern breeds of chickens It may be that the development of this characteristic in many birds preceded the domestication and use of chickens for either meat or eggs This sport has continued down through the centuries, and although there are laws against cockfighting in most, if not all, of the United States, men still continue to breed fighting cocks, both large and bantam size, and very probably they are not bred just to look at

Today nearly every country in the world has its varied assortment of breeds and varieties of chickens In the United States the prospective poultryman has a larger number of varieties of chickens to select from than is the case in any other class of livestock In fact the number is so large and the variations so great that the beginner may have a real problem deciding what breed to select This matter should be relatively simple however, if a person is planning to go into the poultry business with the idea of making it a profitable enterprise The number of varieties which have been bred for economic production of meat and eggs is very limited This chapter will deal particularly with a discussion of these important varieties

CLASSES, BREEDS AND VARIETIES[1]

The American Poultry Association was founded in Buffalo New York, in 1873 The membership represented leading poultry breeders from the United States and Canada The object of the organization was to standardize the varieties of domestic poultry which had become so numerous and in many cases so similar, that there was considerable confusion in judging and breeding them The first *American Standard of Excellence* was published in 1874 Later the title of the publication was changed to the *American Standard of Perfection,* and it has served for many years as a guide to judges and breeders of Standard bred fowl

In the 'Standard Classification' poultry is first subdivided into classes There are twelve classes of chickens and one each of ducks, geese, and turkeys The class designation is usually

[1] Space does not allow a discussion of the historical development of breeds nor the enumeration of all the varieties of Standard bred chickens For this and other information the *American Standard of Perfection* and other references listed at the end of this chapter may be consulted

associated with the geographical origin of the birds, as the American, the Mediterranean, and the Asiatic classes. The classes are subdivided into breeds. Breed is determined largely by size and shape. Breeds are further subdivided into varieties, which are characterized by variations in color or comb, or both. There is still a further subdivision which is of considerable importance to breeders and buyers of poultry but which is not set forth in detail in the *American Standard of Perfection*. Each variety may have many families or lines of breeding which are designated as strains. Strain variations may be very important in the selection of foundation stock in breeding for Standard characters, meat, or eggs.

TABLE 13. SUMMARY OF BREED DISTRIBUTION IN NATIONAL POULTRY IMPROVEMENT PLAN HATCHERY SUPPLY FLOCKS, 1941–42 TO 1946–47: TOTAL NUMBER OF BIRDS AND PERCENTAGE DISTRIBUTION BY VARIETIES FOR ALL STATES REPORTING

Year and Number of States Reporting	Total Birds	New Hampshire	White Leghorn	White Rock	Barred Rock	Rhode Island Red	White Wyandotte	Cross Mated [1]	Others
		Per Cent	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent
1941–42 33 States	10,712,027	21.2	24.1	15.6	16.2	12.5	3.1	2.0	5.2
1942–43 40 States	15,780,980	19.2	26.6	18.3	15.7	8.9	2.8	3.0	5.5
1943–44 42 States	20,331,999	19.4	25.9	19.7	13.9	8.3	2.6	5.5	4.7
1944–45 39 States	17,573,321	23.2	25.8	17.5	12.4	8.0	2.3	7.2	3.7
1945–46 30 States	19,432,779	23.0	23.7	17.7	11.1	7.8	2.1	11.0	3.7
1946–47 33 States	23,010,694	23.0	25.3	18.0	9.9	6.5	2.1	11.0	4.2

[1] Data on cross-mated flocks are not truly indicative of the situation since in several states birds in such flocks are reported under the respective purebred heading and in some states these flocks are cross-mated only for a portion of the year to produce broilers; for the remainder of the year they are mated as purebreds for the production of purebred chicks.

In order to be able to distinguish between breeds and varieties it is necessary to be familiar with the names of the various sections and parts of the fowl. A nomenclature chart of the male chicken is shown on page 41.

American class. As the name indicates, the breeds and varieties in this class were developed by American breeders. The primary objective in developing the birds of this class was to produce a chicken to serve the general purpose of supplying both meat and eggs. The early emphasis was on color and type, the latter being determined largely by feather contour. Several varieties have been developed, all of which have certain common

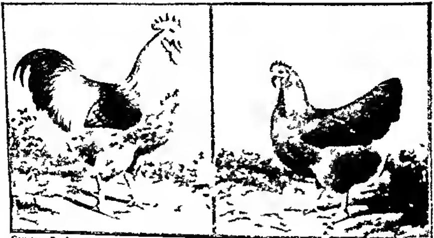
York City market, and premiums are often paid for market birds simply because they have barred feathers One of the most popular birds for the production of winter broilers has been the Barred Plymouth Rock or crosses between the Barred Plymouth Rock male and New Hampshire or Rhode Island Red female All the chicks are barred If this cross is made the other way using the Barred Plymouth Rock female, the males will be barred and the females black or black and gold With this cross it is possible to sex the chicks at hatching time, and many of the sexed pullets are reared and used for commercial egg production

In recent years the White Plymouth Rock has gained in popularity very rapidly and now in many sections of the country exceeds the number of the Barred variety Since the white plumage is free from dark pinfeathers and leaves no stain on the surface of the skin there has been an increasing demand for White Plymouth Rock chicks for broiler production In some strains of this variety the rate of growth is not satisfactory, the egg production is rather low and the rate of feathering is slow For these reasons this variety has not come into general use in some sections of the country

The White Plymouth Rock has become very popular in Kansas and some other Central Western states where much of the poultry is dressed, frozen, and shipped to eastern markets The Kansas Experiment Station has had work in progress for a number of years with the White Plymouth Rock in an effort to improve meat type and egg production and to establish rapid feathering A great deal of improvement has been made in all these characters, and when such stock becomes widely distributed, the White Plymouth Rock should become by far the most popular white variety of general purpose fowl

The other varieties of Plymouth Rocks are the Buff, Silver-Penciled, Partridge, Columbian, and Blue They are bred, in small numbers by persons interested in these particular color patterns

New Hampshires The rise of the New Hampshire, first in New England and then throughout the United States has been more rapid than that of any other breed of chickens The origin of the breed is somewhat obscure but it is pretty generally



Courtesy Poultry Tribune

New Hampshires

believed that Rhode Island Reds taken to New Hampshire from Rhode Island and Massachusetts about thirty years ago were used as foundation stock

In the development of this breed first known under the name of New Hampshire Reds the methods followed differed greatly from the practices carried out in producing most of the present Standard varieties of chickens Instead of placing emphasis on type and color, characters of economic importance were given first consideration In referring to the early breeders of New Hampshires a member of the New Hampshire Club of America recently wrote They cared not a whit for color or undercolor Instead they emphasized such qualities as livability, fast growth good feathering early maturity and production That s what they wanted—eggs and meat—and they didn t want just a little but they wanted a lot of eggs all year round and they wanted meat early in a chicken s life Well, among other things that s what they got

How did they do it? Frankly I m not sure I know exactly how they did it but they did it. I know one way they did part of it They used their eyes They could see that one chicken grew better and feathered better than another That then was a step They picked out those birds and used them as breeders It didn t tax their eyes too much to tell a chicken was laying a lot of eggs and they used these birds for breeders too

By the almost universal practice of using cockerels and pul

lets for breeders each year a rather remarkable breed of chickens has been developed by New Hampshire farmers. The breed was admitted to the Standard in August, 1935. The Standard weights are pullet, 5½ pounds; hen, 6½ pounds; cockerel, 7½ pounds; cock, 8½ pounds. The general color pattern is the same as the Rhode Island Red but is much lighter in shade.

Courtesy Poultry Tribune

Single-Comb Rhode Island Reds.

While the greatest numbers of New Hampshires are found in New England, stock has been distributed to all sections of the United States and to many foreign countries. In the New England area the breed is practically free from pullorum disease because of continuous testing. It has a reputation for excellent fertility and hatchability, for low mortality both during the rearing period and in the laying house, and for very rapid growth. Most strains of the breed are rapid feathering, which is an important characteristic in broiler production. The breed as a whole has reasonably good production. New Hampshires produce large numbers of hatching eggs which are moved into the large broiler-producing areas on the eastern shores of Delaware, Maryland, and Virginia. Many chicks are sent direct from hatcheries in New England. Certainly as a general-purpose fowl the New Hampshire has already established itself as one of our most important breeds.

Rhode Island Reds. The Rhode Island Reds were developed by farmers of the Little Compton District of Rhode Island. A need was felt for a better meat chicken in this area where there was a good demand for large roasting chickens. The early crosses were made between Malay Games and reddish-colored Shanghais. Later new blood was introduced by the use of such

breeds as the Brown Leghorn, the Cornish, and the Wyandotte.

As with most of the other American breeds, fanciers took up the breeding of the Rhode Island Reds and the Single-Comb variety was admitted to the Standard in 1904 and the Rose-Comb variety in 1905. In many cases too much emphasis was placed on type and color at the expense of production qualities. Here again the fancier demonstrated his skill in the art of breeding with the result that many individual birds were produced approaching perfection in Standard requirements. The Standard weights are pullet, 5½ pounds; hen, 6½ pounds; cockerel, 7½ pounds; cock, 8½ pounds. These weights are the same as for the New Hampshires.

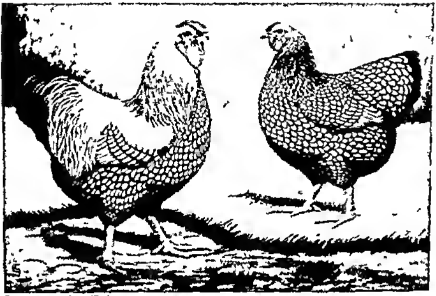
While fanciers were producing a Rhode Island Red with beautiful type and color, other poultrymen, notably in Massachusetts, directed their breeding operations toward the production of high egg-laying flocks. Today many strains of Single-Comb Rhode Island Reds rank among our highest producers of eggs for commercial purposes. In breeding for high egg production certain other characters have been neglected, and as a rule the high-producing strains do not measure up to the Standard for type and color set by the fancier.

In some sections of the United States the Rhode Island Red is the most popular general-purpose fowl. Among many strains there is need for improvement in rate of growth, rate of feathering, and plumage color.

Wyandottes. All the varieties of this breed have rose combs. Nearly every part of the bird is described as being well rounded. The legs are moderately short and in many strains the feathering is moderately loose. The first variety to be admitted to the Standard was the Silver-Laced in 1883. The White variety arose as a sport from the Silver-Laced and was admitted to the Standard in 1903.

The White variety has been the most popular of the Wyandottes and at times has been used extensively by farmers in some sections of the country as a general-purpose fowl. It has been handicapped by small egg size and relatively low hatchability. In some states it still enjoys a measure of popularity, while in other sections it has practically disappeared. The other varieties of Wyandottes are not bred to any extent commercially.

Other breeds. The remaining breeds in the American class



Courtesy Poultry Tribune

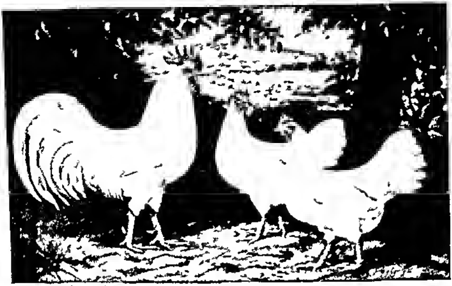
Silver-Laced Wyandottes.

have not been generally accepted by the farmer and have been bred for the most part by persons interested in them from a breed standpoint. They include the Dominiques, Javas, Chanteclers, Jersey Black Giants and Lamonas. The Jersey Black Giant is interesting because it has the distinction of being the largest of the Standard breeds of chickens

Mediterranean class. This class is made up of several breeds which had their origin near the Mediterranean Sea. The Leghorns and Anconas come from Italy, the Minorcas from Minorca Island, the Spanish and Blue Andalusian from Spain, and the Buttercups from Sicily. These breeds are characterized by white ear lobes, relatively large combs, nonbroodiness, early maturity, rapid feathering, nervous disposition, and the production of white shelled eggs. With the exception of the Minorca all these breeds are medium to small in size. They are often referred to as the egg-laying breeds.

Leghorns. Of the twelve varieties of Leghorns now described in the Standard only one, the Single-Comb White, has attained wide commercial acceptance. The Brown, Buff, and Black varieties are next in favor.

The Leghorn has been described as a bird of rare beauty and attractiveness, style, and alertness. This is true as the Leghorn was bred and developed by the fancier. The production breeder has bred a more rugged bird which lacks some of the


Courtesy Poultry Tribune

Single Comb White Leghorns

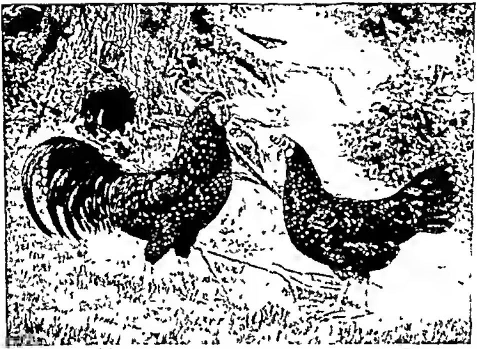
refinements of breed type but which possesses utility characteristics that make it the most popular and most economical producer of white shelled eggs for market purposes of any of our domestic chickens

The Single Comb White Leghorns have been consistent winners in the egg laying contests of the United States, and more than one pen of these efficient producers of white eggs have averaged to lay more than 300 eggs per bird For many years they have been raised almost exclusively over large areas along both the Atlantic and Pacific seaboards They still are unexcelled as producers of large white eggs for which a premium is paid in many large markets of the country

The Standard weights are pullet 4 pounds, hen, 4½ pounds, cockerel, 5 pounds cock 6 pounds Some strains of production Leghorns exceed these Standard weights

Anconas The Ancona is similar in all respects except color to the Leghorn There are two varieties, the Single Comb and the Rose Comb Mottled Anconas, and they could very well have been included under the Leghorn breed

Minorcas The Minorca is the largest of the Mediterranean class It differs further from the Leghorn in being much more angular in shape and in having a white skin Partly because of their large size the Minorcas are noted as producers of large


Courtesy Poultry Tribune

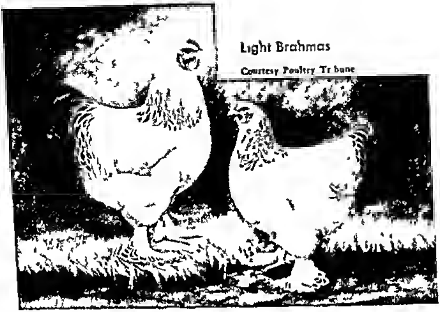
Single-Comb Anconas.

eggs. The fact that they have a white skin has been a distinct handicap, as most consumers in the United States prefer poultry with a yellow skin.

There are five varieties of Minorcas listed in the Standard. The Single-Comb Black, Single-Comb White, and Single-Comb Buff seem to be the most popular.

Other breeds. There are three additional breeds in the Mediterranean class, namely, Blue Andalusians, Buttercups, and White-Faced Black Spanish. These birds are kept primarily by persons interested in them because of certain peculiar characteristics which they possess.

Asiatic class. The breeds of this class are of Asiatic origin, are large in size, and may be considered as meat-producing fowls. They differ in one important respect from the breeds of the American and Mediterranean classes in that they have feathered shanks and feet. They also tend to be very loosely feathered. They are not now of any great practical value, but have exercised, directly or indirectly, great influence upon the development of the American breeds and because of this fact have rendered the poultry industry of America a distinct service. Their popularity as distinct breeds has decreased rapidly during



Light Brahmas

Courtesy Poultry Tribune

the last two decades and they are now bred primarily as a hobby by fanciers Excellent representatives of the breeds in this class may still be seen on exhibition at the leading poultry shows

Brahmas It may be accepted that the Brahma originated in India where fowls of the original type are found, under the name of the Gray Chittagong The first specimens were imported to America in 1846 and to England in 1853 These birds were light in color and probably did not differ greatly from our modern Light Brahma This variety was admitted to the Standard in 1874 The color pattern is that commonly known as the Columbian The Dark Brahma is silver penciled and was admitted to the Standard the same year as the Light variety The Buff Brahma was recognized as a Standard variety in 1924

Cochins This breed attracted wide attention in the 19th Century because of its profuse feathering It has often been described as a ball of feathers Apparently those who developed the breed, in conformity with its present standard, placed most emphasis on the character of feathering

It was first imported to America about 1847, and at that time the birds were called Shanghais Two years earlier it had been imported to England and the fact that Queen Victoria received several birds of this breed and exhibited them at the show of the


Courtesy Poultry Tribune

Buff Cochins.

Royal Dublin Society in April, 1846, started a boom in poultry raising which lasted for a considerable period of time. In America the Cochins have been bred primarily by fanciers and have never been popular with commercial poultrymen.

The four varieties of Cochins—Buff, White, Black, and Partridge—were admitted to the Standard in 1874 Many fanciers breed the four varieties of Cochin bantams, which are identical with the large fowls except for weight.

English class. The breeds of this class were developed in England and are recognized as general-purpose fowls The emphasis in selection has been more toward a meat-type bird than is true of the breeds in the American class The breeds in the English class include Orpingtons, Cornish, Australorps, Dorkings, Sussex, and Redcaps. They all have white skin except the Cornish, which has yellow skin. They have red ear lobes, and all except the Dorkings and Redcaps lay brown eggs Most markets in the United States prefer poultry with yellow skin and therefore discriminate against these white-skinned breeds.

During World War II, because of high prices and a constant heavy demand for poultry meat, a keen interest in better meat quality developed. The Cornish, formerly called the Cornish Indian Game, is a very closely feathered bird and has a very compact body, with broad breast and thick heavy thighs. Be-

cause of its excellent meat type body some poultrymen have used the Cornish in crosses for the production of broilers and roasters The egg producing ability of the Cornish is so low that it is doubtful if such a program will be used very widely. Trouble with low fertility has also been experienced.

Other Standard classes The *American Standard of Perfection* describes several classes of chickens which are bred primarily by fanciers and which have little economic importance. They are of considerable interest to the fancier or research worker because of their peculiar feathering, color patterns, and size, as well as other odd characteristics which render them poorly suited for practical purposes Many of the breeds of these classes, although common on the farms in Europe, are not very popular in America and are seldom seen except at poultry exhibitions

Polish class The Polish breeds and varieties are characterized by a large crest and were once called the "Crested Dutch" Some varieties have a beard and some are nonbearded They are among our most ornamental and beautiful breeds of poultry, the crest being their most striking characteristic They create a great deal of interest in poultry exhibitions

Hamburg class Although this class has a German name, its origin is Dutch Some of the varieties were developed in England and all six were admitted to the Standard in 1874 The Silver Spangled is probably the most striking of all the Hamburgs

French class Of the four French breeds—Houdans, Crevecoeurs, La Fleche, and Faverolles—only the Houdans enjoy any popularity in America They are like the Polish in that they have a large crest They also have a beard and muffs and have five toes The Mottled variety is seen most often

Continental class This class consists of one breed, the Campines, with two varieties Silver and Golden While they are similar to the Leghorns in some respects, they have not become popular in America

Game and Game Bantam class Game and Game Bantams are raised primarily for exhibition and ornamental purposes Although cockfighting is not allowed in the United States occasionally reports are made that the sport still flourishes in some sections of our country

Oriental class The breeds—Sumatra, Malays, and Cubalayas

—in this class resemble game birds in some respects and as the name of the older breed implies, their origin was in southeastern Asia.

Ornamental Bantams. There are a great many breeds and varieties of Bantams. They are bred for fancy and ornamental purposes almost entirely. In this class are grouped a few of the more outstanding breeds and varieties. By an examination of the Standard of Perfection it will be seen that for many of the large varieties of fowl there is a corresponding variety of bantams, differing only in size. A great deal of pleasure is derived by many people in the breeding of these miniature fowl.

Miscellaneous class. The Sultans and the Frizzles, the two breeds composing this class, are bred only for exhibition purposes or are used in a limited way in research.

NON-STANDARD BREEDS AND VARIETIES

Before a breed or variety is recognized as Standard it must be accepted by the American Poultry Association and the Standard requirements agreed upon, after which the requirements are published in the *American Standard of Perfection.* Breeds and varieties which have not been approved by the American Poultry Association are referred to as Non-Standard. There are a number of such varieties, including Jersey White Giants, S. C. Rhode Island Whites, Araucana, and Naked fowl. None of these varieties are of economic importance.

In 1948 a joint committee of the National Poultry Improvement Plan and the American Poultry Association tentatively accepted two non-Standard varieties—the Delaware, developed in the state of Delaware, and the White Australorp, developed in the state of Michigan—for participation in the U. S. Approved and U. S. Certified breeding stages of the National Poultry Improvement Plan. The Delaware is a meat-type fowl with a Barred Columbian color pattern and may be used as a pure breed or it may be crossed on other breeds to produce white-feathered chicks. It is used largely in the production of broilers and fryers.

CHOOSING A BREED

It is already apparent that the prospective poultry keeper has a very large number of breeds and varieties to choose from.

When you consider that there are more than 160 different varieties of chickens described in the *American Standard of Perfection*, differing widely in size shape color muscular development and egg producing ability and when you realize that all probably originated from one or a few wild species it may be said that no matter whether you are interested in meat production or egg production or in the growing of poultry in the back yard for ornamental purposes you should be able to find a variety possessing the size and shape of body and the plumage color pattern that will satisfy you no matter how exacting you may be Even today with so many varieties available not all are satisfied and new breeds and varieties are in the making

The question What is the best breed of chickens to raise? is not an easy one to answer The choice will depend upon egg and poultry prices the type of poultry enterprise that is to be followed and perhaps to a limited extent personal preferences Markets may have considerable influence on the most profitable type of bird to keep Very often the most money is made and the highest prices are received by catering to their whims Leghorns which lay white eggs are popular on market egg farms near New York City because white eggs sell at a premium on this greatest of all egg markets New England markets prefer brown eggs and as a result most of the market egg farms in that area have heavy breeds which lay brown eggs In other areas the question of eggshell color may not be important

If one desires to produce poultry for meat one of the rapid feathering rapid-growing heavy breeds would be best Crosses are very popular for meat production in certain areas particularly when birds are marketed alive and there is a preference for plumage color as is true of the barred plumage feathers on the New York market

When the final selection of a variety is to be made it is always well to consider the ones which are most popular in the immediate locality or section of the country provided they belong to the general type desired The fact that a breed is popular is a good indication that it is well adapted to the economic conditions of that section such as markets soil climate and available food supply and that it is making money for the

poultrymen who keep it You should have a definite interest in and a liking for the breed selected, for you are seldom successful with a thing you do not like or take no pleasure in working with

SUGGESTIONS AND QUESTIONS

1 Have the class make a list of all the important characteristics of the American Mediterranean, and Asiatic classes of chickens Determine which characters are most important in differentiating between representatives from each of the three classes

2 What varieties in the American Mediterranean and Asiatic classes are commercially important in the United States?

3 Have the instructor secure copies of a key to the identification of all standard breeds and varieties of chickens Make a trip to a poultry show By use of the key have each member of the group identify as many breeds and varieties as possible

4 Make a list of all the factors that should be given consideration in the selection of a variety of chickens to raise

5 What are the two most popular varieties of chickens in the United States? Explain the reason for their popularity

6 There are many backyard poultry flocks scattered throughout the country, many of them being found in villages and small towns What are the reasons for this type of poultry keeping?

7 The dairy farmer and the farmer who is in the business of producing beef cattle would not usually obtain replacement stock from the same source Is this fact of any importance to the poultry farmer?

8 Bantam chickens are very popular in poultry shows What are some of the reasons for this popularity?

9 What is necessary before a variety of chickens is recognized as a standard variety?

10 Make a survey of the varieties of chickens kept in your locality

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CHAPTER 3

Principles and Practices of Poultry Breeding

DEFINITION OF POULTRY BREEDING

POULTRY BREEDING is both a science and an art. It is a vocation or an avocation open to more people interested in livestock than is true of any other farm animal. More than 85 per cent of all farms in the United States keep poultry. In addition, many persons residing in small towns and villages keep a few chickens. Some are interested in the birds because of the eggs and meat produced and others breed and raise a few birds purely as a hobby.

There are certain characters possessed by poultry, and particularly chickens, which make small scale, as well as large scale operations, possible and interesting. First, the unit is small and a great deal of variation exists. Six to a dozen small Bantams take up only a little space. Second, the time of reproduction is short and many progeny can be obtained from a single mating in any one year. Third, the life span is short. Fourth, progress comes easily. For these reasons a great many people, old and young, derive much pleasure and profit from the breeding of poultry.

Poultry breeding may be defined as the reproduction and inherent improvement of domestic birds. Reproduction is primarily concerned with the replacement of older individuals with individuals that are younger. Many poultrymen are in the business of multiplying stock with little or no emphasis on improvement. Others, by the use of various breeding techniques, are making an effort to replace their birds with stock that is inherently better. Actually only a limited number of poultrymen

are in position and have the qualifications necessary to carry on a breeding program which will result in marked hereditary improvement

REPRODUCTION

The process of reproduction or the transmission of life from one individual to a succession of new ones its offspring may be effected in various ways

In the simplest cases commonly called *asexual* or vegetative reproduction the body of the parent or adult form becomes divided into two or more parts each of which develops into a new individual In animals this method is uncommon except in the very simplest types In this method of reproduction the possibility for the appearance of new and different types is somewhat limited

Far more common and of considerably more importance than asexual reproduction is that called *sexual* Here the function of forming a new individual is delegated to single cells which are set apart for this purpose Sexual reproduction consists in the union of two specialized sexual cells called *gametes* to form one cell the fertilized egg or zygote from which develops a new individual A variety of structures are present in animals and plants to insure the successful consummation of this process Except in the lower forms the gametes themselves are produced in specific reproductive organs called *gonads* which have certain accessory sexual organs In animals the male gametes are known as *sperms* and are produced in a *testis* and the female gametes as *eggs* or *ova* produced in an *ovary* At fertilization a sperm and an egg come together and unite The single cell resulting from this union begins to divide forming a group of cells which gradually differentiate into the parts of an embryo and finally into an adult organism

In sexual reproduction it is apparent that each parent contributes to each of its offspring a single minute cell a small portion of living substance so minute in size that it cannot be seen by the unaided eye Since this is the only direct physical link between parent and offspring it is across this narrow bridge that everything must pass which is transmitted from one generation to another

As a result of this reproductive process a continuous succession of new individuals arises One of the most interesting features of the process is that the new individuals tend to resemble their ancestors very closely The offspring of a strawberry plant develop into strawberry plants and not into anything else When two White Leghorns are mated the offspring will all be White Leghorns and not White or Barred Plymouth Rocks Certain characteristics may be transmitted with considerable uniformity through a number of generations This similarity among individuals with common ancestors is called *heredity* Since heredity tends to maintain the characteristics of different species of plants and animals it is the basis of all classifications and makes it possible for poultrymen to classify domestic birds into classes, breeds, and varieties as described in Chapter 2

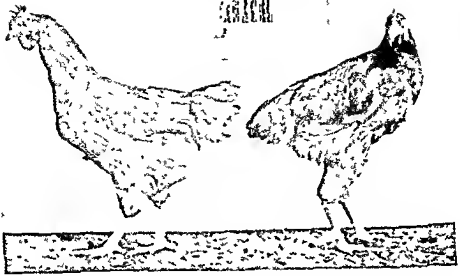
VARIATION

While the offspring of any single mating may be uniform and resemble the parents closely, they are almost never exactly alike A group of offspring from the same parents will differ among themselves and some or all of them may differ from their parents These differences are usually referred to as variations, and are often due to distribution of traits among the offspring according to a definite method of inheritance Many variations are due to environmental influences such as differences in heat, light, moisture, and food, as well as many other factors Variations are therefore of many kinds and are due to many causes An individual in its definitive form then, is the result of both hereditary and environmental influences

Variation is of extreme importance to the poultry breeder It is in fact the basis of all improvement If all the individuals in a flock of birds were exactly alike with reference to their reproductive cells further selection would be useless as no improvement could be expected

REPRODUCTIVE SYSTEM

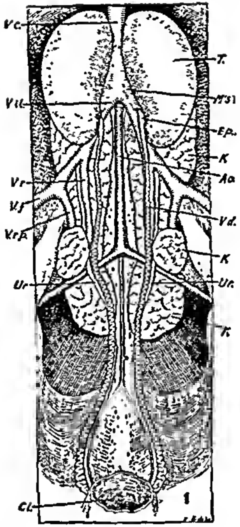
The male and female fowl have special organs associated with accessory organs for the development of the reproductive



Vigor is important in both meat and egg production. The cockerel on the left shows high vigor.

cells—the sperm and the egg—which make it possible for these two sex cells to come together in fertilization.

The male reproductive organs. In the male the reproductive organs consist of a pair of *testes,* leading from each of which there is a tube called the *epididymus,* which connects with the *vas deferens,* or sperm duct, which continues to the *cloaca.* The testes are situated in the body cavity, one on either side of the backbone anterior to the kidneys. The vasa deferentia open into ducts which lie directly above a groove in a rudimentary copulatory organ. It is the presence of this small copulatory organ in male chicks that makes possible the segregation of chicks according to sex soon after they are hatched. By a careful examination of the vent of the newly hatched chicks it is possible to determine the presence or absence of the organ. If the organ is present it will appear as a small pimple, often called the "point," on the lower rim of the vent. Most of the male chicks have a relatively prominent "point," while in most females it is entirely absent. A few chicks of both sexes may have a relatively small prominence, and it is these chicks which make trouble for the inexperienced person. Several weeks training

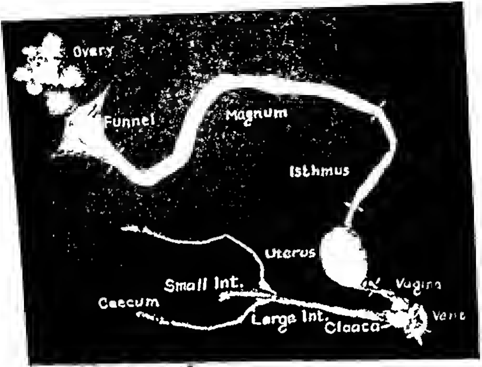


Courtesy L. V. Domm, University of Chicago

The male reproductive and urinary systems: T., testis; V.d., vas deferens; K, kidney; Ur., ureter; Cl., cloaca; H, head of reproductive cell or sperm; T, tail of sperm.

may be necessary in order for a person to qualify as an expert chick sexor.

The female reproductive organs. The reproductive system of the female consists of an *ovary* and its accessory organ the *oviduct*. The function of the ovary is to develop the female reproductive cells, the *ova*, and the oviduct conducts the ova from the ovary to the cloaca. There are several additional functions of the oviduct. It serves as a passageway for the sperms, which are deposited by the male in the cloaca, to enter the body cavity where fertilization may take place; or the sperm may be in the *infundibulum* of the oviduct when it envelops the ovulated



Courtesy J E Parker University of Tennessee

The female reproductive system and a portion of the intestinal tract

yolk As the yolk passes down the oviduct it is surrounded by several layers of albumen membranes and shell which nourish and protect the embryo

The ovary is located on the left side of the body in the adult bird During embryonic development a right ovary and oviduct develop but gradually degenerate until at hatching time only rudiments remain A few cases have been reported of adult birds having a right and a left ovary and oviduct In the adult fowl the ovary is located on the left side of the median line of the body just back of the lungs and is attached to the dorsal wall of the body cavity In the immature pullet the ovary appears as a light-colored mass of material while in the laying hen it is of considerable size and appears as a cluster of yellowish yolks of varying size

TERMS USED IN BREEDING

Each individual animal is composed of many characters A character is any detail of structure form substance color function or size of an individual Characters constitute the indi

vidual, its activities and products The inheritance of characters is based on the transmission of *genes* from parent to offspring Genes are defined as the determiners of hereditary characters They occur in pairs, with a few exceptions, and are associated with other pairs of genes located in bodies known as *chromosomes* Normally one of a given pair of genes is located in each of a corresponding pair of chromosomes One of these chromosomes, hence one of the genes, was derived from the sire and its mate from the dam

One member of a pair of genes may be different from its mate This may occur in a cross between two breeds in which the form of a certain character is not the same in both breeds To illustrate this point, the comb character in chickens is a good example A bird resulting from a cross between a purebred rose-combed and a single combed bird will receive a gene for rose comb from one parent and a gene for single comb from the other The bird resulting from this cross will exhibit a rose comb, since the rose comb gene is *dominant* and prevents the expression of the other member of the pair, the single comb gene, which is known as a *recessive* The gene for single comb has not been changed in any way and under certain conditions is capable of again producing a single comb If two of the rose combed crossbred birds are mated together, in the next generation both rose- and single-combed individuals will appear in the ratio of three rose combed birds to one single combed bird Of the rose combed birds from this mating one out of three will be pure breeding and two out of three will not breed true possessing like their parents, one rose comb gene and one single comb gene The birds which possess two like genes and breed true are *homozygous* for this gene The pure breeding rose combed and the single combed birds are homozygous for comb shape genes Rose combed birds which possess two unlike genes will not breed true for comb shape and are *heterozygous* The diagram on page 64 illustrates this cross

The usual method of designating genes is by the use of letters Capital letters are used to indicate the dominant conditions, and small letters the recessive The gene for rose comb is usually represented by R and that for single comb by r The actual constitution of an individual with respect to these particular genes is known as the *genotype,* which is designated by the

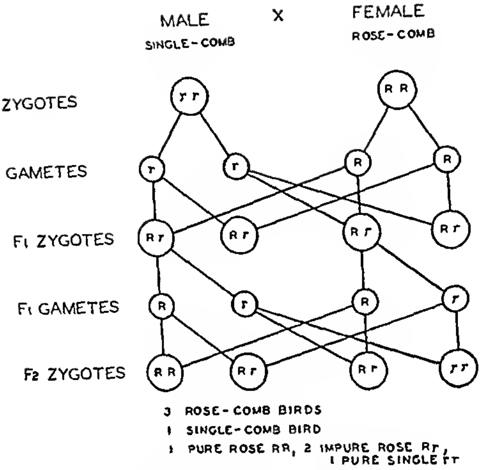


Diagram of a cross between rose comb and single comb in chickens

genes of which it is composed. With respect to comb shape the genotype of the single-combed bird would be represented by the letters rr; that of the pure breeding rose-combed bird by RR; and that of the heterozygous rose-combed bird by Rr.

The appearance of the bird with respect to these characters is called the *phenotype*. *The phenotype is often spoken of as the* visible or measurable type in contrast to the genotype. In the illustration cited there are only two phenotypes: one the single comb, to which the bird with the rr genotype belongs; and the other the rose-comb, to which the birds with both the RR and Rr genotypes belong. In this case the phenotype of the single combed bird is identical with the genotype, and when selected on the basis of phenotype alone would be expected to breed true.

for the single comb character On the other hand, the two genotypes that show the rose-comb phenotype can be distinguished only by breeding tests If a rose combed bird bred to a single-combed bird produces only rose combed offspring, then it must belong to the RR genotype and would breed true for the character rose-comb, but if it gives some single combed offspring, then it must belong to the Rr genotype

Not all genes show complete dominance when two unlike genes are present in the pair governing the expression of a character Neither gene completely suppresses the action of its mate In such cases incomplete dominance is said to exist A common example in chickens is that of the color of the Blue Andalusian The blue color does not breed true, as it is always present as a result of the presence of unlike genes of a gene pair When blue birds are mated, the mating consists of two heterozygous individuals which produce three phenotypes in the offspring, which correspond to the three genotypes present The three phenotypes are black, blue, and splashed white, and they occur in the proportion of one black, two blue, and one splashed white

The number of pairs of genes present in the germ plasm has never been determined for any plant or animal The number of chromosomes, on the other hand, is known for many plants and animals and the fact has been established that each species has a constant number of chromosomes occurring in pairs For example, in man there are 24 pairs or 48 chromosomes, and in the small fruit fly, ***Drosophila,*** there are only 4 pairs of chromosomes The number of chromosomes in chickens has not been determined finally, but it is large and is probably 40 pairs or a total of 80 in the male and 39 pairs and one unpaired chromosome in the female There are two kinds of chromosomes autosomes and sex chromosomes The latter are called sex chromosomes because of their importance in sex determination

SEX DETERMINATION

The male chicken has two sex chromosomes and the female only one In germ cell formation the female produces two kinds of eggs, one with a sex chromosome and one which lacks a sex chromosome They are produced in approximately equal numbers Since the male has two sex chromosomes all sperms

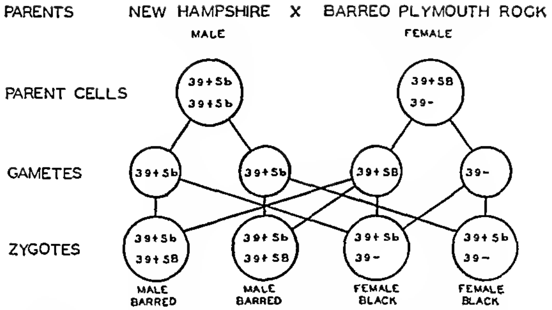
contain one sex chromosome and therefore do not differ in this respect When an egg containing a sex chromosome is fertilized it will develop into a male but when an egg lacking a sex chromosome is fertilized it will develop into a female therefore approximately an equal number of males and females results

SEX LINKED INHERITANCE

The fact that the male chicken has two sex chromosomes and the female but one results in a type of inheritance called sex linked inheritance The genes responsible for certain characters are located in the sex chromosomes These characters are often referred to as sex linked characters An example will make clear this type of inheritance

The barred plumage pattern of the Barred Plymouth Rock is a simple sex linked character The gene which causes barring is a dominant gene the recessive condition being nonbarred When a Barred Rock male is crossed with a black or red female all the progeny is found to be barred If however a black or red male is mated to a Barred Rock female in the first generation the females are found to be black or reddish black and the males are all barred Sex linked crosses for early sex identification are made possible by this principle

The reason for the behavior of the sex linked genes lies in the fact that the male has two sex chromosomes as in the case of all other genes while the female has only one sex chromosome and hence only one of the sex linked gene pair Therefore the genotype of the pure Barred Rock male is BB while the genotype of the female is B— In the black or red birds the genotype of the male is bb and the females b— In the second cross described above bb × B— black or red male × barred female the male progeny will be heterozygous barred Bb and the females will be black b— As day-old chicks the males will have a distinct white spot on the head and light-colored shanks while the females usually lack the light head spot and are generally darker in color This makes it possible to distinguish the males and females at hatching time with a fairly high degree of accuracy The most popular cross using this principle is between either Rhode Island Red or New Hampshire males mated to



This diagram shows the inheritance of sex and of the sex linked character of barring

Barred Plymouth Rock females The above diagram illustrates this cross

Many externally visible characters of poultry are determined largely by the action of a single pair of genes or the interaction of a very few genes Such characters as comb type and other structural features, skin color, and plumage color are determined in this way Such characters are not influenced greatly by environmental factors and are relatively easy to fix and maintain in a flock of birds

Unfortunately most of the economically important characters of poultry are not inherited in this simple manner They are produced by the combined action of a large number of genes This results in wide variations, and to add to the difficulty, these characters are influenced greatly by conditions in the environment

POULTRY BREEDING PAST AND PRESENT

Until the beginning of the present century interest in poultry breeding was centered largely in the production of birds with varied types, combinations of colors and adornments The result was the development of the large number of Standard varieties of chickens which are still common today These poultry-

men had little or no knowledge of genetics—the science of heredity and variation—but attained astonishing results through patience, careful selection, and the application of techniques known to them at the time and by developing new methods as they progressed in their work. Some attention was given to egg-production characters in this early work and resulted in the development of the Mediterranean breeds—the Leghorns, Anconas, and Minorcas—which have long been known as egg-producing birds.

These early poultry breeders, often referred to as poultry fanciers, developed varieties of chickens a number of which have proved to be excellent foundation stock for the intensive breeding program of the last fifty years which has had for its purpose the improvement of egg-laying ability.

Some of the first work done in improving strains of birds for egg production by experimental methods was carried out at the Maine, New York, and West Virginia Experiment Stations. With the invention of the trap nest, the widespread use of the mammoth incubator, and the year-round demand for eggs of high quality, experimental work in the improvement of chickens for egg production has become a major part of the research program of many poultry departments and experiment stations, not only in the United States but in many other countries.

An examination of published records, particularly those of egg-laying tests, reveals the tremendous progress that has been made in the last forty years in the improvement of domestic chickens in the important character of egg production. In 1919, at one of the leading egg-laying tests in the United States, 1,000 birds laid an average of 145.5 eggs. This average was based on the records of the best 1,000 birds of the 1,300 originally entered. In 1947, at the same laying test, 1,352 birds, the original number entered, laid an average of 228.2 eggs. No doubt some of this increase was due to better methods of management and more knowledge of nutritional requirements. Better breeding has played an important role in bringing about this change.

Space does not permit a discussion of the methods and practices followed by poultrymen breeding birds for Standard characters of type and color. Such poultrymen are usually very

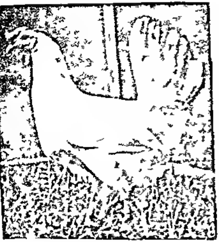
small operators and constitute a very small part of our present-day poultry industry. The commercial poultry breeder, while giving due consideration to type and color, places major emphasis on economic characters of birds. Breeding for economic characters is limited to a small number of Standard varieties.

EGG PRODUCTION

The number of eggs produced by the individuals of a flock of birds is of greater practical and economic significance than any other character which domestic fowls possess. Almost two-thirds of the enormous annual income of the poultry industry is from the sale of eggs. Not only is the number of eggs important, but consideration must also be given to the kind of eggs that are produced. By kind of eggs is meant a product, the size, shape, color, and interior quality of which will meet the exacting demands of the consumer.

Number of eggs. The number of eggs of an individual bird is usually measured by the annual record. Since it is not always possible to determine the complete annual production, a number of other characters have been used, each of which have been demonstrated to contribute to the final number of eggs produced in a year. Most of these characters have been shown to be of an hereditary nature, and therefore careful selection in the right direction for any one or all of them will have a tendency to improve the annual record. The five characters usually considered to be important are sexual maturity, winter pause, broodiness, rate of production, and persistency. Any one of these five characters may be a limiting factor in the annual record of a bird. Spring and summer pauses have been observed by some workers to be a limiting factor in the annual egg record.

Sexual maturity. The age at the time of laying the first egg is usually considered to be the most satisfactory measure of sexual maturity. The Massachusetts Experiment Station has reported from work done on this character in Rhode Island Reds that birds laying their first eggs previous to 215 days of age possess the hereditary factors for early sexual maturity. Many heavy pullets and the majority of Leghorn pullets in good lay-



This White Leghorn hen shows all of the external characteristics of high production.

High vigor and good breed characteristics are shown by this White Leghorn male.

ing strains lay their first eggs before attaining this age. Continual selection for this character, without regard to other characters, may lead to the production of birds that will lay at a very early age, but such birds are usually small in size, lay small eggs for many months, and are generally unsatisfactory. It has been observed that Leghorns laying their first egg at 160 to 180 days of age and heavy breeds laying about 30 days later give satisfactory results.

In connection with this character it must be remembered that other factors besides heredity may influence the age at the time of laying the first egg. Time of hatch may be a factor, as high temperature is known to retard growth rate and in turn to increase the time to sexual maturity. Nutrition may also affect the age at the first egg, poor nutrition tending to retard the rate of sexual maturity. Artificial light is another environmental factor known to affect the age at the first egg. It has been demonstrated in turkeys that the use of artificial illumination may shorten the period of sexual maturity as much as two months

The exact nature of the inheritance of sexual maturity has not been determined. There is evidence, however, that sex-

linked factors may be involved The importance of this character and its relation to the annual egg record are made apparent in work done at the Cornell University Agricultural Experiment Station By the use of the progeny test over a five year period in an effort to reduce egg production in an already low fecundity strain of White Leghorns, the average age at the first egg was increased from approximately 245 days to 352 days. Average annual egg production was reduced from 103 to 40 eggs Changes in sexual maturity was the most important factor affecting the decrease in average annual production.

The identification of both early and late maturing birds is relatively easy The trap nest record, of course, will show the date of the first egg The approximate date can be determined by physical examination, as indicated in Chapter 4

Pauses The three groups of interruptions which may occur during the time between the laying of the first egg and the annual fall molt may all be considered under the general heading of pauses

1 Broodiness This type of pause is nothing more than the normal instinct of birds to incubate their eggs in the process of reproduction It is common to most wild birds and is much more prevalent in the heavy breeds of our domesticated chickens—Plymouth Rocks, Rhode Island Reds, and New Hampshires The Leghorns are relatively free of it No strain of any breed, however, has been reported to be completely nonbroody.

Broodiness has been the subject of a great deal of study for many years, and considerable information has been obtained relative to it As a result of these studies it has been postulated that two complementary dominant genes are responsible for its expression This means that both dominant genes must be present in an individual if she shows broodiness It is apparent then that one strain of birds may have one of the dominant genes and a second strain have the other and neither of the strains will be broody If two such strains are crossed, however, the offspring may show rather intense broodiness, one of the necessary genes for broodiness coming from the sire and the other from the dam It is a well known fact that crossbred pullets may give a great deal of trouble during the spring months

because of excessive broodiness and for this reason many poultrymen dispose of their crossbreds for market soon after they begin to go broody

The activating agent in the bird s body which causes broodiness is a hormone secreted by a small gland at the base of the brain known as the pituitary The anterior lobe of the pituitary is active in producing this hormone It has been found that males and females of broody strains of birds produce more of this hormone than do nonbroody birds

Birds vary widely in intensity of broodiness Some birds may go broody only once during the year while others may have as many as five broody periods during the first year of production Occasionally a bird will not show broodiness until in the second year of production

Since only a small percentage of chicks are now hatched by natural incubation this character is no longer of any value in commercial flocks and the time consumed in broody periods by the hen is lost time Broody hens will remain on the nest most of the time which means that eggs laid by other hens may be subjected to continued high temperatures thus lowering their market quality

Selection against broodiness is relatively simple If trapnesting is being done families showing broodiness can be eliminated In a general flock a colored legband can be placed on any bird found broody on the nest and these birds can be disposed of later and not allowed to get into the breeding flock Many strains of heavy breeds in which careful selection has been practiced are almost free of broodiness

2 Winter pause No very clear analysis of this character has yet been made In the first place there is no general agreement as to the loss of time necessary to constitute a pause The time has varied with different workers from 4 to 15 successive nonlaying days It has been shown that the tendency to pause varies from strain to strain and between individuals of the same strain and that the tendency can be checked by careful selection and family testing

In a study of this character serious complications arise because many factors in the environment operate to bring about temporary secessions in egg production The relative influence of heredity and environment is very difficult to determine

The evidence indicating winter pause is usually very apparent From an economic point of view the most important change is a lowering of egg production This may be as much as 10 per cent and often much more in a flock of pullets and is caused by individual birds ceasing to lay. The drop in egg production will usually be accompanied by a lowering of total food intake, and a certain amount of head, neck, and body molt may occur Such factors as sudden changes in management, rough handling while culling or at other times, and sudden climatic changes often hasten and intensify pause

That winter pause does have a marked effect on egg production is well demonstrated by records from the California Experiment Station Birds showing a pause of 7 or more days were found to lay on the average about 56 eggs during the period from November 1 to the end of February, while nonpausing birds during the same time laid on the average 77 eggs, the winter production of the nonpausing birds being over one third greater

Evidence has been reported that winter pause is the result of a single pair of dominant genes Since such wide variation occurs with respect to this character, it is probable that its inheritance is very complex

3 Spring and summer pauses In addition to the pauses occurring in winter and those due to broodiness, there are other periods of interruption of egg production which may appear during the spring and summer These secondary interruptions produce the same effects as the other pauses, but they seem to be caused by different things It has not been reported as to whether hereditary factors are concerned in the production of these pauses

Persistency This character is measured by how early a bird ceases production or by how long she continues in production towards the close of her first laying year, cessation of production usually being followed by a complete molt Its importance was recognized by James E Rice as early as 1914, and for many years was accorded more weight than any other single character in the certification of breeding stock in New York State

Several methods of measuring persistency have been suggested among which are the length of the biological year, which

This New Hampshire hen laid 316 eggs with a point score of 344.3 in 365 days.

includes the time elapsing between the date of the first egg laid and the last egg laid; production in August and September; and age at the last egg or date at the last egg. The length of the biological year is as much dependent upon sexual maturity as on persistency and hence is not as satisfactory a measure as the other methods suggested. For practical purposes in most flocks the date of the last egg seems to be an adequate criterion of persistency.

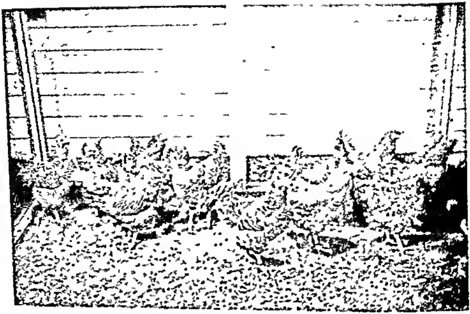
Whatever measure for this character is used, selection by the breeder can be readily applied Early molting hens usually lack persistency, while late molting is associated with late laying. Occasionally strains of birds are found which continue to lay very late into the fall during the time of highest egg prices. Birds which are to be used as breeders should not be held in production too late as they may not have time to return to full production after the molt by the time hatching eggs are desired. At least three to four months should be allowed for the birds to rest and get back into full production from the time they stop laying until chicks are wanted.

There is some evidence to indicate that the character persistency is inherited in a simple manner, one pair of dominant genes being involved This explanation seems inadequate in the case of a quantitative character where so much variation is observed to occur.

Rate of production. A bird may possess the characters already described in satisfactory form and still not make a high record because she lays at a low rate. This character has often been referred to as intensity of production. Many ways of measuring intensity or rate have been suggested, the most common of which is the use of percentage of production. This measure of rate may not always be satisfactory, as the period chosen to

This pen of Single-Comb White Leghorns, starting with 13 birds, laid a total of 3,679 eggs, scoring 3979.35 points, or 283 eggs and 306.1 points per bird.

These Single-Comb Rhode Island Reds, starting with 13 birds, laid a total of 3,540 eggs, scoring 3733.3 points, or 272.3 eggs and 287.18 points per bird in 51 weeks.



This pen of 13 Barred Plymouth Rocks laid a total of 3,899 eggs, scoring 4088.3 points, or 299.9 eggs and 314.48 points per bird in 51 weeks.

determine rate may include pauses the causes of which may be different from those of rate. Probably a more accurate method of determining rate would be to eliminate from the record the days lost in pauses and determine rate during the time of continuous production. This measure may be referred to as net rate of production and is determined by eliminating pausing days from consideration.

Rate or intensity of production may be determined for any time during the year or for the entire year. Short periods seem to be more desirable. The correlation between winter rate and annual production is sufficiently high to make it useful as a basis of selection.

Average cycle has often been used as a measure of intensity. A cycle of eggs is the number of eggs laid on successive days. One or two days of nonlaying occur between each cycle. The best layers lay in long cycles with few intervals, while the poor layers lay in short cycles with intervals of one or more days between the cycles.

That rate of production is influenced by hereditary factors has been demonstrated. Unfortunately there is no accurate way of determining rate without the use of the trap nest. A short

trap nesting period is usually sufficient in the determination of rate.

It is obvious, then, that in order for a hen to make a high record she must possess all of these characters in desirable form. The Massachusetts Experiment Station has reported on how the annual record of a bird is affected in individuals lacking one or more of these characters. The results are shown in Table 14.

In the improvement of these characters, which results in improvement in the annual record, more rapid progress can be made in improving any one character if selection in the breeding program is limited to that character. In this way one character at a time is fixed in the strain of birds. It has been found, however, that this method of improvement is not as satisfactory

TABLE 14 RELATION OF NUMBER OF DESIRABLE CHARACTERS TO ANNUAL EGG PRODUCTION, 1938–42

NUMBER OF DESIRABLE CHARACTERS	NUMBER OF BIRDS	PER CENT OF BIRDS	AVERAGE EGG PRODUCTION
1	10	.82	124 90
2	69	5 66	157 39
3	393	32 21	187 96
4	439	35 98	223 89
5	309	25 33	251 60
Total	1,220		

as selecting for all characters simultaneously, thus bringing about over-all improvement.

Egg characters. In addition to the number of eggs produced by a bird, there are several characters of eggs of considerable economic importance. Some of the more important characters are size, shape, shell quality, color of shell, interior quality, and abnormal eggs. The quality of an egg, as far as the hen can determine it, is fixed at the time it is laid.

Egg size. The size of an egg is usually determined by weight and is one of the most important quality characters in commercial eggs. Eggs may vary in size from ½ ounce to 4 ounces. A 2-ounce egg (56.7 grams) is usually considered standard. Rigid selection for egg size during recent years has brought about marked improvement in this character among laying flocks in general. The point system adopted at egg-laying tests has been

an incentive to produce birds which attain standard egg size soon after they start to lay

There are several factors which may influence egg size Strain variations within a breed are of more importance than breed variations Body weight within a strain or breed is an important factor in determining egg size Very small birds do not lay large eggs On the other hand not all large birds lay large eggs A bird weighing 4 to 5 pounds is apparently large enough to produce eggs of standard size As birds increase in size from these weights they become less efficient as egg producers It is probably not a sound practice to produce over-size eggs They do not pack or ship well and often present a problem in marketing

Sexual maturity may affect egg size Usually the earlier the maturity the smaller the egg High rate of production may be a factor in egg size but no serious problem is presented Many individuals with high records also maintain satisfactory egg size Once egg production starts the rate of increase is very important Strains of birds vary greatly with reference to this character and some may fail to lay 2-ounce eggs until after they have been in production 5 to 6 months.

First year egg weight may be based on the weight of all eggs laid the eggs laid on one day out of each week all eggs laid during the first 10 days in March the weight of the 50th and 200th eggs All of these measures have been used as a basis for selection in breeding programs It is not necessary to weigh all eggs in order to get a satisfactory measure of egg size Average egg size of the first year is usually slightly below that of the second year Little change takes place in egg size for several years Beginning with the fifth year or later a slight decrease may occur

Egg size is inherited It is influenced by both sire and dam Some investigators have thought that small egg size was dominant to large others have held the opposite to be true It is evident that the method of inheritance is not a simple one By selecting hatching eggs carefully however egg size may be improved and maintained. Eggs weighing less than 2 ounces each from pullets or at the minimum rate of 24 ounces per dozen and eggs weighing less than 26 ounces per dozen from hens should not be used.

Egg shape The normal egg is ovoid in shape. Eggs may

have many abnormal shapes, but long eggs or round eggs are the most common varieties. Egg shape is determined in the oviduct. Some doubt exists as to just what brings about the shape of an egg. Recent observations would indicate that the magnum, or albumen secreting section of the oviduct, plays an important part in shaping the egg.

Opinions differ as to the method of inheritance of this character. Work at the Pennsylvania Experiment Station would indicate that a number of hereditary factors are involved.

Egg shell color. As indicated in Chapter 12, this character is of considerable economic importance in certain markets. Most eggs are classified as either white or brown. One breed of chickens, the Araucana from South America, lays a blue egg. Actually there is no relation between color and nutritional value in eggs. If birds are fed the same rations both kinds of eggs will be equally good. Breed differences have been noted, however, in the amounts of certain nutritional factors in eggs.

Brown egg color is dominant to white. The dominance is not complete, for the offspring of matings between white and brown egg breeds usually produce eggs intermediate in color. In many crosses where the White Leghorn is used as one of the parents mated to a brown egg breed, the eggs of the progeny are neither white nor brown and in certain markets may be discounted. Blue egg color is dominant to both white and brown egg color. Crossed with a white egg breed the progeny has a light blue egg. If one of the parents is from a brown egg breed, the progeny usually lay an egg that is olive green in color.

Brown or blue eggs show a seasonal variation in color. Eggs that are medium to dark brown or dark blue at the beginning of the laying period may be several shades lighter after the bird has been in production for several months.

Color of egg is influenced by both male and female, and there is some evidence to indicate that sex linked genes may be involved. It is not a simple character. Even in breeding a white-egg breed, constant selection must be practiced in order to keep at a minimum the number of hens laying tinted eggs. Breed only from birds laying chalk white eggs. One of the most difficult problems faced by the breeder of most heavy chickens is to produce a strain of birds which lay uniformly brown shelled eggs.

Shell quality. The most important factor affecting this char-

acter is egg shell thickness Since thickness of shell is associated with breaking strength proper thickness is necessary for safe transportation The amount of shell secreted by the hen is definitely affected by nutritional factors Both calcium and vitamin D must be present in the diet in required forms and amounts if the hen is to produce satisfactory shell quality Even though the nutritional requirements are met variation may still result between breeds and between birds in the same variety or strain This variation would indicate that heredity plays a part in determining shell quality

By careful selection strains of birds have been produced differing widely in the amount thickness and percentage of shell present in their eggs Breed only from birds laying strong shelled eggs and incubate only eggs free from rough spots wrinkles and weak ends

Interior egg quality This is a very complex character The information is still far from complete on the various factors both hereditary and environmental which may affect interior egg quality Space does not permit a detailed discussion of the several different measures which have been developed in connection with research on this character

Color of yolk and yolk index $\frac{\text{height of yolk}}{\text{average width of yolk}}$ have been given greater consideration in connection with yolk quality than other measures Color of yolk is determined almost entirely by diet Yolk index does not in general vary as widely in new laid eggs as do the characters of the white

The two most used measures in egg albumen studies are the percentage of thick white and the score for the observed condition of the albumen The latter consists of a set of photographs of varying qualities in new laid eggs which are used as standards The illustration on page 387 shows a set of these standards

A number of workers have shown that these two measures of quality are not affected materially by feed or management but that they do have an hereditary basis Work at Cornell University Agricultural Experiment Station has demonstrated that strains of birds could be developed by selection showing rather wide difference in the score of the albumen Two lines of birds were bred for several generations at the Beltsville Maryland United States Department of Agriculture Research Center for

high and low percentages of thick white. The high thick-white line averaged 65 per cent thick white, while the low line averaged only 40 per cent thick white. At the same station the research workers have developed a heat-resistant type of thick white in a flock of White Leghorns. This type of thick white stands up well for about 14 days at 100° F. and is a distinct improvement over ordinary thick white which retains its initial quality for a very short period under such severe conditions.

The method of inheritance of these characters has not been determined. In most cases the method is complex, but improvement can be and is being made by careful selection.

Abnormal eggs. Among this class of eggs the one abnormality causing the poultryman most trouble, particularly where eggs are sold directly to the consumer, is that of blood spots and meat spots. These two conditions may well be considered together as there is considerable evidence to indicate that they have a common origin. Surveys of farm flocks have shown that the incidence of blood spots may range from 15 to 50 per cent. As a rule; the eggs produced by White Leghorns have fewer blood spots than the eggs of the heavy breeds.

At the Beltsville Poultry Research Center the incidence of blood spots ranged from 61 per cent in Rhode Island Reds to 4 per cent in White Leghorns. Two lines of Rhode Island Reds bred at Beltsville differed greatly in the number of blood-spot eggs produced. One line produced eggs which averaged 80 per cent blood spots and the other only 20 per cent. The results obtained in these two lines show rather clearly that blood spots are due to heredity and that the incidence of blood spots may be reduced by breeding.

Hatchability. Hatchability may be defined as the ability of eggs to hatch or produce chicks under proper environmental conditions. Hatchability is a complex character affected by heredity, nutrition, incubation, and management. The hatcheryman is interested in the number of chicks he gets from each 100 eggs set, and determines his hatchability on the basis of the percentage of total eggs set. Since hatchability and fertility are two different characters, influenced by different factors, the research worker determines hatchability on the basis of fertile eggs that hatch. Obviously fertility is necessary for hatchability, but high fertility is not necessarily associated with high hatchability.

Fertility is thought by some experts to be inherited but the evidence on this point is very meager. Fertility may be influenced by several environmental factors.

Hatchability tends to decline as the age of the breeding female increases. This is one reason why pullets are used instead of older birds for the production of chicks. High producing hens tend to lay more hatchable eggs than low producing birds. Very large eggs do not hatch as well as medium sized eggs. There is some evidence to indicate that in breeds laying brown eggs those eggs having medium to dark brown shell color hatch better than those with light brown color.

Hatchability is an inherited character. Evidence has been reported indicating a simple type of inheritance but most investigators now agree that it is a complex character affected by many genes. It is a well-established fact that there are a number of lethal genes (genes that kill) which may affect hatchability. The action of a single pair of lethal genes may reduce hatchability 25 per cent in individual matings. Inbreeding usually lowers hatchability while crossbreeding has a stimulating effect.

Since hatchability is inherited, it is obvious that the hatchability of a flock can be increased by proper selection of males and females. To be done most efficiently, it will be necessary to use the progeny test. By saving breeding stock from families giving a hatchability of 85 per cent or more, a high hatching strain can be developed.

Viability. Viability may be defined as the ability to survive a normal life span, and it is important to the poultryman that a bird produce efficiently during this period. Under normal conditions of feeding and management the span of life of the average chicken is relatively short, so that frequent replacement is necessary. Many poultrymen find it a profitable practice to replace the entire flock each year. Others who are carrying on breeding work may replace one half to two thirds of their birds. If birds could be bred which would produce profitably for a number of years, replacement costs would be reduced.

There are three major groups of conditions which operate to shorten the life of chickens and to reduce their usefulness to man. Group I includes improper diet or conditions of life. Group II consists of parasites which may invade the body of the

bird In Group III are degenerative changes developing within the body of the bird without the aid of an external agent. As in most classifications of this kind, there is some overlapping

Group I	*Group II*	*Group III*
Rickets	Fowl Pox	Prolapse of cloaca
Vitamin deficiencies	Coccidiosis	Reproductive disorders
Perosis	Newcastle disease	Visceral gout
Cannibalism	Leucosis complex	Crossbeaks
Mineral deficiencies	Pullorum	Hunchback
Accidental deaths	Roundworms	Rumpless
Crop impaction	Tapeworms	Too large
	Bronchitis	Too small
	Tuberculosis	
	Lice and mites	

In the case of Group I, the most expedient remedy is to correct the fault in feeding and management Hereditary ability to resist deficiencies of diet and certain environmental conditions have been demonstrated

In Group II, the most effective measures of control are eradication of the parasite, vaccination, and isolation Under farm conditions some of the diseases do not always respond to these measures of control For these particular diseases and practically all those in Group III the most effective means of control is by breeding

The plant breeder has made noteworthy advances in the production of many strains of small grains and other important food plants which are resistant to specific diseases During recent years the animal breeder, and especially the poultry research worker, has been making use of breeding techniques in an effort to produce resistant strains of chickens for specific diseases, notably the group of conditions now referred to as the "leucosis complex' The poultryman is familiar with these conditions under the common names of range paralysis gray eye and big liver disease Such pathological conditions are often referred to as lymphomatosis or neoplasms by the pathologist

An analysis of the mortality occurring at egg laying tests, in experiment station flocks and on certain farms shows that more than one half of the deaths is due to diseases of the leucosis complex and associated causes Since there is no effective treatment

possible use of the disease resistance that has been established by breeding

An important consideration in connection with disease resistance is that available evidence indicates that such resistance is specific The establishment of a strain of birds resistant to one disease does not mean that the strain will be resistant to any other disease On the other hand, it does not mean that the strain will be unusually susceptible to some other disease Each disease presents a separate problem in breeding for resistance There is considerable doubt in the minds of many research workers as to whether breeding for resistance to certain diseases is at all practical Those diseases for which specific control measures have been developed, such as pullorum disease, can be handled more easily by such means than by breeding

SELECTING BREEDING STOCK FOR BROILER PRODUCTION

The demand for meat chickens and the development, in certain areas, of poultry farms devoted primarily to the raising of broilers and fryers have created interest in breeding stock having superior meat characteristics To aid poultrymen in producing better broilers the United States Department of Agriculture and many of the experiment stations have conducted investigations on this problem The studies have demonstrated that by observing certain characteristics in day old chicks and growing stock a poultryman can select breeding stock that will improve his flock in regard to broiler and fryer production This can be accomplished in most of the common breeds with little or no loss in egg production characteristics and at little additional cost

The plan consists in the selection of chicks for fast feathering, as shown by the number and size of the wing and tail feathers and a later selection of the growing chicks for efficient and rapid growth and for superior meat production Selection on the basis of these characters results in marked improvement in the quality of broilers or fryers produced The selection is a continuous process, applied to both males and females and continued throughout the life of the breeding stock

Fast feathering Fast feathering is desirable in birds that are

to be used for meat production because the chicks from such stock have a minimum of pinfeathers at broiler or fryer age If there are many pinfeathers present at the time birds are killed and dressed dressing is more difficult and the appearance of the carcass may be lacking in the finish that is desired Such birds usually bring less per pound than birds that are well finished

Selection to obtain breeders that feather rapidly is most easily accomplished at hatching time Fast feathering is a sex linked recessive character When mated together male and female breeding birds which are known to be fast feathering will produce only fast feathering chicks Most Leghorns and many strains of New Hampshires are fast feathering Strains of Rhode Island Reds and White and Barred Plymouth Rocks with fast feathering are gradually being developed

Rate of feathering can be determined in day-old chicks by the length of the primary and secondary wing feathers and the number of the secondary feather sheaths The chicks with the most rapid rate have well-developed primaries and secondaries with six or more secondaries The chicks of the slow feathering type have no secondaries or less than six short ones and no primaries or very short ones

After some experience a poultryman can select chicks of the fast feathering type so that almost all of the selected birds will have relatively large primary and secondary wing and tail feather development at 10 days of age and they will be fully feathered with a minimum of pinfeathers at 12 weeks of age Such birds are best for breeders

Rapid growth Efficient rapid growth is best measured by the weight of the bird at an early age The greatest variability in the growth of cockerels has been shown to occur between two and six weeks of age if a good diet is fed and the cockerels have access to direct sunlight and free range Therefore this is the best period in which to make accurate selection of the most efficient birds by their body weights During this period there are maximum differences in weight between the slowest growing the average and the most rapid growing individuals These differences become less after the fourth week until at maturity there may be little or no difference Further selections of the birds showing rapid growth should be made at ap-

proximately 20 weeks of age and just before they are placed in the breeding pens

Breast development. Broilers generally have only fair breast development Since the breast meat is the most valued part of the broiler, it is important that this characteristic should be given careful consideration in breeding for meat production Observations of the breast development should be made when the birds are from 6 to 12 weeks of age When making observations, each bird should be examined and all birds should be held in a similar position when the examination is made A good way to make this observation is to hold the chickens by the legs in the left hand, with its head downward, keeping the right hand free to examine the width and length of the breast By comparisons, the birds can be divided into three or four grades Mark those birds for breeders which have long, wide well fleshed breasts

At the same time the birds are being examined for breast development, observations may be made on any imperfections of the breastbone or skin, such as crooked and dented breast bones and breast blisters Any individual with such imperfections should not be used as a breeder With a little experience the poultryman soon learns to judge the relative breast development in birds of the same age fairly accurately

SYSTEMS OF BREEDING

In order to improve the production qualities as well as other characteristics of poultry several different systems or methods of breeding are practiced by poultrymen They are inbreeding, line breeding crossing and outcrossing

Inbreeding This system of breeding has never been very successful or popular with poultrymen It consists of mating related individuals Close inbreeding is the mating of closely related birds such as brother to sister or sire to daughter Such a method of breeding tends to bring about genetic purity in the inbred birds This would be desirable if the resulting inbred birds possessed only desirable characters but unfortunately the undesirable characters are also intensified at the same time and often at a more rapid rate than the desirable characters

When close inbreeding is practiced, especially without very careful selection of the breeding stock the results are likely to

be unsatisfactory Hatchability is usually lowered and mortality among the chicks is often relatively high and their rate of growth is in many cases retarded In the adult inbred stock body size may be reduced thus lowering egg size and the number of eggs produced may be lowered materially Since inbreeding intensifies both bad and good characters great care must be exercised in its use In the hands of the skillful and experienced poultryman it may be an excellent aid in the improvement of strains of birds but in the hands of the untrained and careless it is likely to be a source of danger

A relatively new application of the principle of inbreeding in poultry has developed during recent years This principle has been applied to the breeding of corn for many years until at the present time strains of hybrid seed corn largely replace the open pollinated varieties formerly used This new method involves the close inbreeding of a large number of lines of one or more varieties of chickens and the careful selection of the most promising lines for crossing If the cross is made between two inbred lines of the same variety the progeny are referred to as incross chickens If an incross White Leghorn male resulting from a cross between two inbred lines of White Leghorns is mated to a Rhode Island Red female which came from a cross of two inbred lines of Rhode Island Reds the resulting progeny are referred to as incrossbred chickens The incrossbreds are the chicks sold by hatcheries which are now producing them to poultry farmers for commercial egg and meat production The results obtained from the limited number of these birds which have been produced is very encouraging Reports indicate that the chicks live and grow well and the adult stock performs very satisfactorily under commercial conditions In poultry production as in corn growing hybrid stock may in time tend to replace many of the purebred varieties now found in commercial and farm flocks

Line breeding Line breeding is systematic inbreeding It is usually carried out by the repeated use of certain desirable individuals and their offspring in successive generations for the production of inbred strains It was used by the fancier to fix the characteristics of an outstanding male or female A male was often mated to his daughters and then later to the female offspring resulting from the mating with his daughters This

method of breeding aims to reduce the dangers arising from promiscuous mating of closely related individuals. Line breeding, if properly conducted, makes it possible for a breeder to develop several families of birds within the same flock which are similar in breeding, with many common ancestors but not closely related. By the use of such a plan a strain can be maintained for several years without using any outside blood unless the flock is small.

In such a system trap-nesting and pedigree-hatching are almost necessary if satisfactory results are to be obtained.

Crossing. Crossbreeding is the mating together of individuals of different breeds or varieties and is expected to result in what is called "hybrid vigor" in the progeny. Essentially a chicken has hybrid vigor when it performs better than its parents or the average of its parents. It cannot be predicted in advance of mating tests what parents will give hybrid vigor in their progeny, except in the case of very closely inbred strains which always exhibit hybrid vigor when compared with their inefficient parents. Breed crosses are more likely to exhibit hybrid vigor than crosses of strains within the breed. The cause of hybrid vigor is not clear.

The term "crossbred" is used commercially to indicate the first cross between two varieties. Those who produce crossbreds hope for hybrid vigor. They hope that the crossbreds will produce better than the parents. Sometimes they do and sometimes they do not. In producing crossbreds it is important that specific strains be used. There is no purpose in crossing two breeds if the resulting crossbred is no better for broiler production or for egg production than the parents.

In general, crossbreeding usually results in better hatchability, livability, and growth rate in chicks. Its effect on egg production and mortality in the laying flock is variable. One disadvantage of this method of breeding is that two separate breeds must be maintained or made available for the production of crossbred stock.

Some of the most popular crosses now being made are between Barred Plymouth Rocks and New Hampshires or Rhode Island Reds. If the Barred Plymouth Rock female is used in the cross the chicks may be sexed at hatching time because of differences in color between male and female. The popular

black pullets used for egg production and market purposes are obtained from this cross If the Barred Plymouth Rock male is used all the adult crossbreds are barred

A sturdy farm chicken produced by crossing Australorp males with White Leghorn females is very popular in the west, from Minnesota and North Dakota to the Gulf of Mexico They have white skin and the females have blue shanks

Dark Cornish males are often mated to New Hampshire females a mating which produces a crossbred with black red color They excel as plump breasted broilers

White Leghorns and Rhode Island Reds are used most extensively in the development of inbred lines to be used in the production of incrossbreds

Males with the Columbian color pattern are being used with New Hampshire females in the production of broiler chicks

Outcrossing The introduction of new blood of the same variety, usually through a male, is known as outcrossing Many poultrymen use this method in improving their laying flock With the development of inbred lines of chickens a method known as topcrossing has been introduced This procedure consists of mating an inbred male to random bred females If the females are the same breed as the male the progeny is called a topcross If the female is a different breed or variety the progeny is a topcrossbred At present these types are not being produced extensively

BREEDING PLANS AND PROGRAMS

Many breeding plans have been developed by research workers both state and federal as well as by individual poultrymen, as a means of improving the productive ability of farm flocks That progress has been made is apparent by the fact that during the ten year period from 1936 to 1945 the average number of eggs produced per layer on farms during the year increased from 121 to 152 eggs The most extensive plan for poultry improvement now in operation is that conducted by the Bureau of Animal Industry of the United States Department of Agriculture It is called the National Poultry Improvement Plan

National Poultry Improvement Plan The National Poultry Improvement Plan was put in operation July 1, 1935 An Act of Congress made it possible for the Bureau of Animal Industry, United States Department of Agriculture to co-operate with

state authorities in the administration of regulations for the improvement of poultry, poultry products, and hatcheries.

The objectives of the National Poultry Improvement Plan are to improve the breeding and production qualities of poultry and to reduce losses from pullorum disease. The objectives are being accomplished by (1) the development of more effective state poultry-improvement programs; (2) the identification of the quality of breeding stock, hatching eggs, and chicks by the use of authorized terms that are uniform and applicable in all parts of the country; and (3) the establishment of an effective co-operative program through which newer knowledge and practical experience can be applied to the improvement of poultry and poultry products.

Acceptance of the plan is optional with states and individual members of the industry within any state. The plan is administered in each state by an official state agency co-operating with the Bureau of Animal Industry, United States Department of Agriculture.

The Bureau of Animal Industry, through its representatives, known as poultry co-ordinators, carries out the following functions: (1) administers the plan in a uniform manner among all the states when the work is undertaken; (2) assembles, analyzes, and disseminates information on poultry breeding and pullorum-disease control that will be of benefit to the poultry industry; (3) advises the representatives and leaders of the industry concerning breeding and disease-control problems with which the poultry industry is confronted; (4) approves all antigen used in the rapid, whole-blood test for pullorum disease; and (5) permits the use of the prefix "U. S." in connection with other terms in describing, advertising, and selling hatching eggs, chicks, and breeding stock of the various classes when attained and when satisfied that all the rules and regulations of the plan have been complied with.

The official state agency is the agency recognized by the Bureau of Animal Industry, United States Department of Agriculture, to co-operate in the administration of the plan within the state. The state agency may be a state poultry-improvement association, the State Department of Agriculture, state poultry-improvement boards, or other agencies recognized officially by the state government. Some of the official state agencies' major functions are the following: (1) to direct, supervise, and be re-

on the performance of the progeny A U S Register of Merit sire is a male which when used in a supervised single mating has at least one half and a minimum of 20 of his daughters that are entered in U S Record of Performance qualify A U S Register of Merit dam is a female which when used in a supervised single male mating has at least one half and a minimum of 4 of her daughters entered in U S Record of Performance qualify Relatively few poultry breeders are in position to take advantage of this most important stage in the National Poultry Improvement Plan

In the pullorum phase there are four progressive classes recognized in the plan The U S Pullorum Tested flock is a flock in which all birds to be used as breeders have been tested when more than five months of age and contain fewer than 5 per cent reactors on the last test In some states this class is not recognized

The U S Pullorum Controlled class has a permitted tolerance of fewer than 2 per cent reactors on the last test the test being made within 12 months immediately preceding the date of sale of hatching eggs or chicks from such flocks

The next class recognized is the U S Pullorum Passed In this class no reactors are permitted on the last test

The highest pullorum class in the plan is U S Pullorum Clean Flocks may qualify for this class by either having two tests at least 6 months apart or three tests at least 30 days apart with no reactors on any of the tests Testing for this class must be done by state pullorum testers

For complete details of this plan a copy of Miscellaneous Publication No 300 the National Poultry Improvement Plan, may be secured from the Bureau of Animal Industry, United States Department of Agriculture, Washington, D C

A practical breeding and management program for egg production The following outline presents the essential features of a sound breeding program for individual poultrymen interested in maintaining and improving the production qualities of his stock

1 Use only pure varieties as classified by the American Poultry Association and described in the *American Standard of Perfection* The most common breeds used for egg production are as follows

sponsible for all the work done relative to flock selection in the various breeding stages and to testing for pullorum disease as provided in the plan (2) to conduct efficiently the inspection work called for in the plan (3) to arrange for and hold schools to train flock selecting and pullorum testing agents (4) to arrange for the holding of examinations and to authorize candidates who qualify to do flock selecting and pullorum testing (5) to keep accurate and detailed records of all work relative to the plan and (6) to inspect advertising of all participants of the plan

The plan is divided into two phases namely the breeding and pullorum-disease phases

In the breeding phase there are four progressive stages The U S Approved stage is based on physical selection of both males and females The birds entered in this stage far exceed the number entered in any other phase of the plan Individual poultrymen and hatcherymen meeting the minimum requirements of this stage may produce and sell U S Approved hatching eggs baby chicks or breeding stock

The second breeding stage the U S Certified is based on physical selection of males and females but in addition the males must be U S Record of Performance males which are individually pedigreed This last requirement is the main difference between U S Approved and U S Certified flocks U S Certified hatching eggs and chicks are produced in U S Certified hatcheries

The third breeding stage the U S Record of Performance is based on individual performance A U S Record of Performance female must meet the following requirements (1) lay 200 or more eggs during the first laying year (2) produce eggs of at least 24 ounces per dozen (3) be of at least qualifying body weight for hens (4) be free from standard disqualifications and a reasonably good representative of the breed and variety U S Record of Performance males are produced from U S Record of Performance chicks For example suppose a female has qualified as a U S Record of Performance female She is mated to a U S Record of Performance male in a single mating The chicks are pedigreed The chicks can qualify as U S Record of Performance males following inspection and banding after six months of age

The last breeding stage is U S Register of Merit and is based

on the performance of the progeny. A U. S. Register of Merit sire is a male which when used in a supervised single mating has at least one-half and a minimum of 20 of his daughters that are entered in U. S. Record of Performance qualify. A U. S. Register of Merit dam is a female which when used in a supervised single-male mating has at least one-half and a minimum of 4 of her daughters entered in U. S. Record of Performance qualify. Relatively few poultry breeders are in position to take advantage of this most important stage in the National Poultry Improvement Plan.

In the pullorum phase there are four progressive classes recognized in the plan. The U. S. Pullorum-Tested flock is a flock in which all birds to be used as breeders have been tested when more than five months of age and contain fewer than 5 per cent reactors on the last test. In some states this class is not recognized.

The U. S. Pullorum-Controlled class has a permitted tolerance of fewer than 2 per cent reactors on the last test, the test being made within 12 months immediately preceding the date of sale of hatching eggs or chicks from such flocks.

The next class recognized is the U. S. Pullorum-Passed. In this class no reactors are permitted on the last test.

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For complete details of this plan a copy of Miscellaneous Publication No. 300, the National Poultry Improvement Plan, may be secured from the Bureau of Animal Industry, United States Department of Agriculture, Washington, D. C.

A practical breeding and management program for egg production. The following outline presents the essential features of a sound breeding program for individual poultrymen, interested in maintaining and improving the production qualities of his stock.

I. Use only pure varieties as classified by the American Poultry Association and described in the *American Standard of Perfection*. The most common breeds used for egg production are as follows:

Single Comb White Leghorns
New Hampshires
Rhode Island Reds
Barred Plymouth Rocks
White Plymouth Rocks

II Secure stock which has been bred for egg production

III Selection should be a continuous process

A Select only eggs which are of the correct size shape and color for hatching purposes

1 Size minimum 2 oz average $2\frac{1}{8}$ oz

2 Color if white free from tints if brown uniform

3 Shape typically egg shaped

B Retain only those chicks which are strong and vigorous and free from abnormalities Day old chicks should weigh from 8 to 9 lbs per 100

C Destroy weaklings on range when they appear Best method is to kill and burn Record all losses

D Separate cockerels and pullets as soon as possible and rear on separate ranges

E Cull cockerels at broiler age retaining a sufficient number of the most promising birds from which to select future breeders Cockerels should be well feathered over the entire body at six weeks of age Save at least three times as many cockerels as will be needed for mature breeders

F Use only males which are free from standard disqualifications and are at least standard weight

G The male is half the flock Use the best males possible Should average higher quality than females

H Select by family record and pedigree where possible

IV Good management of males is essential

A Place developing cockerels in open well ventilated shelters or houses near shade if possible Trees make good roosts If tapeworms or coccidiosis are known to be present on the premises shade should be limited

B Both grain and mash are essential on range

C Leave cockerels on range as long as weather permits Avoid freezing of combs and wattles in case the birds are not dubbed Cockerels may be dubbed at any

time, but preferably from six to twelve weeks of age.

D. House cockerels in medium-sized flocks, not to exceed 40 in a group. They should be fed grain and mash in hoppers. More than one hopper should be provided for each group.

E. If satisfactory winter quarters are not available for males, the safest place for them is with the hens. Males should be exposed to artificial illumination for about three weeks before saving eggs for hatching.

V. Hens should be selected carefully.

A. The hens should be culled closely throughout the year and only those retained as breeders which have a minimum weight of 4 pounds in the case of Leghorns and a minimum weight of 5 pounds in the case of Plymouth Rocks, Rhode Island Reds, and New Hampshires. They should show the characters for high egg production as indicated by physical changes and capacity, show reasonably good breed type and color, and be free from standard disqualifications.

B. Birds with known trap-nest records are to be desired.

VI. Breeding females should be managed carefully.

A. Hens should not be held in production too late in the fall. They should be out of production long enough to grow new plumage, regain yellow pigment, body weight, and good physical condition. This will take about two months.

B. Breeders should be in production for at least two weeks before saving eggs for hatching.

C. Start feeding a breeder mash at least three weeks before hatching eggs are saved.

D. Provide artificial lights to give a 13-hour day for breeders 4 weeks before saving hatching eggs.

VII. There are several types of matings.

A. Flock or mass mating. This is the most common type of mating used. In the case of Leghorns there should be one male to each 15 to 20 females; in the heavier breeds one male to each 12 to 15 females. Start extra males so that if one goes out no replacement is necessary.

In case of excessive fighting among males, they may

be alternated, using a smaller number and alternating them once or twice a week

B Pen mating One male with from 10 to 20 females, depending on activity and mating efficiency of the male as determined by fertility and hatchability Ancestry of chicks can be determined on the sire's side if eggs from each pen are hatched in separate hatching compartments and the chicks marked

It is desirable to make more than one special pen mating

(See Breeding Plan No 1 below)

C Individual pedigree mating Trapping either full or part time, pedigree hatching and careful record keeping are necessary

(See Breeding Plan No 2 on page 98)

D Stud mating A variation of the pen system

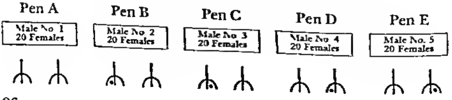
Females are housed fed and managed as a single flock Males are at all times confined to small coops 3 x 3 x 3 feet The females are placed with the males at the time of trapping and are left in the stud coop until the trapping is done the next time They are all removed at the last trapping period of each day

Each male should be designated with a spiral leg band of a certain color, and all females to be mated with a particular male should have the same spiral colored band

E Artificial insemination This method employs special techniques and is used primarily in research work It may be used in the case of aged males or where birds are confined in laying batteries

Breeding Plan No 1 Breeding for Egg Production without Trap Nest (Minimum of Ten Pens Desirable)

First Breeding Year



Select birds carefully Keep eggs from each pen separate and hatch separately Incubate only eggs of desirable type Give all females numbered leg bands Identify chicks from different pens by a toe punch, as indicated, or by wing bands Compare males with respect to the following items

1 Fertility and hatchability
2 Quality and sons reared to maturity
3 Number and quality of pullets reared to maturity
4 Rearing and laying house mortality
5 Handle pullets in January following the first breeding year and compare pens as to number laying, size, and quality

Note Where possible, the daughters of each sire may be housed separately, thus affording a comparison on production, size, and color of egg

Second Breeding Year

Pen A	Pen B	Pen C	Pen D	Pen E
Cock No ? 20 Females	Cock No ? 20 Females	Cockerel No. 6 20 Females	Cockerel No 7 20 Females	Cockerel No 8 20 Females

1 Use two of the best cocks from first breeding year in pens A and B
2 Use three of the best cockerels sired by these two cocks
3 Use the best old hens from pens mated the first breeding year
4 Use in pens A and B a few of the very best daughters
5 Fill up pens with the best yearling hens from the general flock Compare males as in the first breeding year

Third Breeding Year

Pen A	Pen B	Pen C	Pen D	Pen E
Cock No ? 20 Hens	Cock No ? 20 Hens	Cockerel No 9 20 Hens	Cockerel No 10 20 Hens	Cockerel No 11 20 Hens

1 Use the two best cocks mated in the second breeding year
2 Use three cockerels sired by these two cocks
3 Use best of old hens from pens mated the second breeding year
4 Fill up pens with hens, the progeny of birds mated the first breeding year, or exceptional individuals from the general flocks

Always continue selecting for size of bird constitutional vigor, egg quality and freedom from defects

In the third or fourth breeding years new blood may be introduced by the use of a pedigreed male in one of the five pens If the male is to be retained for further breeding he should give distinctly better results than the other males used

More rapid progress will be possible if more cockerels are tested This can be done by having more pens or the same result can be obtained by replacing the cockerels heading the pens after 100 to 150 chicks have been hatched from each pen The tested cock birds should head the pens they are in for the season

Breeding Plan No 2 Breeding for Egg Production, Full or Part Time Trapping (Minimum of Ten Pens Desirable)

First Breeding Year

Pen A	Pen B	Pen C	Pen D	Pen E
Male No. 1 20 Hens	Male No 2 20 Hens	Male No 3 20 Hens	Male No 4 20 Hens	Male No 5 20 Hens

Select birds carefully using pedigreed males if possible

1 Give hens and males sealed numbered leg bands

2 Trap-nest during the breeding season and pedigree hatch

3 Identify all chicks by stamping their wing bands with the sire s pen letter and the dam s leg band number or by use of a serial wing band number

4 Cull at broiler age Make notes of mortality and disposal of cockerels on hatching sheet

5 Save all the promising cockerels

6 Save all old birds which are in good physical condition and have progeny

7 All pullets of desirable type should be trapped (part or full time trapping)

Second Breeding Year

Pen A	Pen B	Pen C	Pen D	Pen E
Cock No.	Cock No. ?	Cockerel 20 Hens	Cockerel 20 Hens	Cockerel 20 Hens

1 Use the best old hens from pens mated in first breeding year

2 Select the best yearling hens from the general flock to fill pens

3 Select the two best males based on results of first year matings and use in pens A and B

4. Use the two best cockerels from the male in A and the best one from the male in B in pens C, D, and E

5 Trap nest during the breeding season and pedigree hatch

Third Breeding Year

Pen A	Pen B	Pen C	Pen D	Pen E
Cock No [illegible] 20 Hens	Cock No [illegible] 20 Hens	Cockerel 20 Hens	Cockerel 20 Hens	Cockerel 20 Hens

1 The procedure is the same as above except the yearling hens will be the progeny of the original 100 birds

2 Each year keep the best hens and the two best males regardless of age as long as they continue to give good results

3 Always keep your objective in view, the efficient production of high quality eggs

4 More rapid progress can be made if more cockerels are tested Increase matings to 10 as soon as practical

In the third or fourth breeding years and at any time thereafter, new blood may be introduced by the use of a pedigreed male in one of the special breeding pens If the male is to be retained for further breeding he should give distinctly better results than the other males used

Techniques in breeding Improvement of the desirable economic characters in poultry is dependent upon the selection of the breeding stock used in reproducing the flock The degree and rate of improvement is dependent to a considerable degree upon the skill of the person doing the selection In selection, any one or any combination of three recognized techniques can be used These techniques are as follows

1 *Selection of individuals for breeding on the basis of their own apparent characteristics*

a Physical selection using as a basis size, condition, pigment, molt, and other external characters

b Selection on the basis of individual trap nest record

2 *Selection on the basis of pedigree* This technique of breeding is based on the fact that matings of superior individuals bred from superior individuals are more apt to produce superior progeny than are matings of superior individuals from unknown ancestors In this method of breeding, three genera

tion pedigrees are superior to one or two generation pedigrees as a means of selection Pedigrees beyond three generations are usually of little importance

3 *Selection on the basis of family performance* This method involves the use of the sib and progeny tests Prospective breeders are selected on the basis of the performance of their sibs that is brothers and sisters Progeny tested breeders are used on the basis of results obtained in previous years

There is no doubt that progress can be made by the first two techniques The second method however is dependent to a considerable extent upon the first Likewise the third method the most effective of the three is dependent upon the first two For the most certain and rapid improvement *a combination of the three methods is essential* The average quality of all poultry can be improved most rapidly and effectively by the wide spread use of superior males

SUGGESTIONS AND QUESTIONS

1 Secure an adult male and an adult female chicken Kill and dress the birds Carefully remove the breast exposing the internal organs Remove the organs of the digestive system Study carefully the reproductive system of each sex Why does the female have only one ovary and oviduct?

2 Sex linked inheritance was demonstrated in poultry less than fifty years ago What is the economic significance of sex linked inheritance today? Make a list of sex linked characters in poultry

3 Discuss all the factors which should be taken into consideration before a poultryman undertakes to carry out a complete progeny test program

4 Write an essay on early attempts to improve egg production in chickens by selective breeding and progeny testing

5 Conduct a community survey to determine the number of flock owners carrying on a selection and breeding program Try to determine if different methods give different results

6 Compare the average number of eggs produced by hens on farms throughout the year in the United States in 1925 and at the present time How would you account for the difference?

7 The selection of breeding stock for the production of chicks for broiler purposes is relatively new What are the important characters that are given consideration in such a breeding progam?

8 The National Poultry Improvement Plan is administered by

the Bureau of Animal Industry of the United States Department of Agriculture co operating with authorized state agencies Secure a copy of the regulations of the plan and study carefully the four breeding stages Why is the U S R O M breeding stage attempted by so few breeders? Secure a copy of the latest directory of the U S Register of Merit Sires and Dams Make a comparative study of the breeding worth of different sires and dams on the basis of the performance of their progenies

9 Secure all the information that can be obtained on the production of hybrid chicks Have a debate on the merits of hybrid chickens as compared to purebred chickens

10 Many poultrymen purchase crossbred chicks for both egg and broiler production What are the advantages and disadvantages of crossbred chickens?

11 A farmer maintains a flock of 250 laying hens He produces market eggs How may this poultryman maintain high egg production and good egg quality in his flock?

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CHAPTER 4

Culling the Farm Flock

PROFITABLE poultry production depends upon a number of management practices one of the most important of which is culling In its broad sense as practiced by poultrymen, culling refers to the sorting of the desirable and undesirable hatching eggs, chicks pullets, cockerels hens, and breeding males The greatest emphasis, however has been placed on the sorting of hens not only to eliminate the nonlayers, but also to remove the birds that are not producing at a profitable rate The material presented here will be limited primarily to a discussion of general practices followed in the culling of the laying flock

Culling chickens for egg production qualities has become in recent years a widespread practice The work is relatively simple and can be learned by most poultrymen, but to become capable of intelligently judging the length of time a hen has been laying the rate of her production and her vacation periods requires more study and considerable practice. The first requisite of successful culling is a normal flock, one that has escaped serious disease epidemics is in good physical condition and has received reasonably good care as to feeding housing and general management

THE KINDS OF POULTRY TO CULL

Most poultrymen now buy their chicks from a commercial hatchery If the hatcheryman carries out his part of the program carefully, he will remove all of the crippled, very small, or weak chicks as he fills the box for shipment Any such chicks which may be received by the poultryman should

be destroyed at once They simply take up brooder space and the time of the caretaker that should be available for the healthy, strong chicks As the chicks develop, scrawny, un promising individuals should be removed from the flock and eaten or sold, and only the rapid feathering, quick growing individuals should be saved

In recent years considerable information has been obtained on the culling of pullets at the time they are ready to go into laying quarters in the late summer or fall The value of four criteria for culling ready to lay pullets at Cornell University was studied in a flock of 2,155 Single Comb White Leghorn pullets The four measures used were fleshing, shank color, symptoms of colds and the presence of irregular pupils These characters were studied in relation to production and mortality The fact that birds had colds when they went into the laying house did not affect production or mortality A high rate of mortality from all causes was noted for pullets which had irregular pupils The use of three of the measures—fleshing shank color, and regularity of the pupils—would have made it possible to reduce the mortality in the flock from 4 to 5 per cent by culling approximately 25 per cent of the pullets at housing time

Table 15 shows the results of estimating future production in pullets obtained at the California Experiment Station The pullets were classified at the time they went into winter quart ers and all birds were trap nested The estimations in this case were very good

TABLE 15 Estimating Future Production in Pullets

Estimated Rating	Average Production	
	1933–34	1934 35
	Eggs	Eggs
A+	171 7	187 5
A	143 8	167 7
B	120 4	149 0
C	70 4	114 4
C−	52 4	92 4

It is obvious that it would be more profitable to eliminate the cull early in life Birds of low vigor which are crow headed,

have small bodies or have long rangy bodies, as well as slow-maturing, off type individuals should be culled before the pullets are placed in the laying house Culling and selecting the breeding males is equally important, and will be treated later

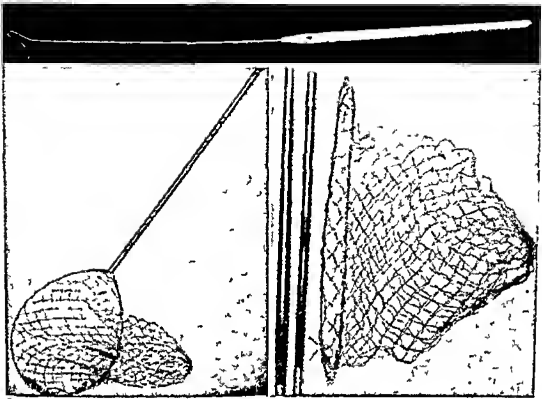
Culling domestic poultry other than chickens has not been given much attention There is no good reason to believe that such birds as ducks geese and turkeys could not be culled much the same as chickens

TIME TO CULL

Culling of poultry of all ages to a limited extent, should be a continuous process because diseased, crippled, and otherwise defective birds should be removed from the flock as they are detected One culling a year sometime during the summer, as is the practice of some farmers with small farm flocks, is not a satisfactory procedure Systematic culling, that is, the handling and examining of every bird in the flock, should start early in July, and sometimes as early as June if the pullets were hatched early the previous year, and continue periodically about once a month until the end of the laying year The number of birds to cull from the laying flock at any time will depend on the current rate of lay and the desired rate of lay Some poultrymen may wish to remove all those not paying *feed costs,* other poultrymen those not paying most of the total production costs The number of birds to be culled in order to raise a flock average from one level to another is shown in Table 16

TABLE 16 The Relation Between Culling Rate and Rate of Production

Number of Eggs Obtained from 100 Layers per Day	Approximate Number of Birds to be Culled to Raise the Rate of Lay per 100 Layers in the Flock to—			
	45	50	55	60
30	33	40	45	50
35	22	30	36	42
40	11	20	27	33
45		10	18	25
50			9	17
55				8
60				0



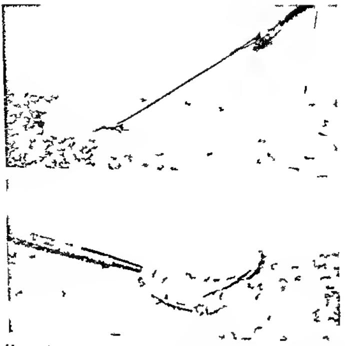
Courtesy L M Hurd

The catching hook (top) and the landing net used in catching individual birds.

According to Table 16, a poultryman with a flock average of 30 eggs a day per 100 layers, desiring to raise his flock average to 50 eggs per 100 layers, would need to remove about 40 non-layers and poor layers from the flock.

The volume of egg production usually reaches a peak in May and declines until a bottom is reached in November. Poultrymen can prevent a large part of this decline in egg production per layer by proper and systematic culling.

No two laying flocks are alike and the amount of culling necessary in any particular flock depends upon several factors. Chief among these are breeding, feeding, and general management. Flocks of poor breeding need to be culled more rigidly than well-bred flocks in order to maintain a satisfactory rate of production A well-balanced ration is essential for high egg production, and it is much simpler to cull the dormant birds or low producers from a flock that has been fed properly. Poor management of any kind tends to increase the amount of culling necessary in order to maintain egg production at a profitable



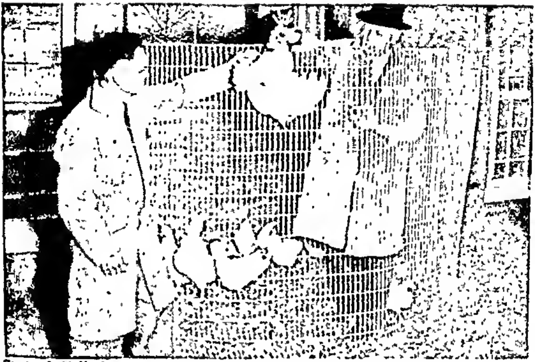
Us ng the hook and the landing net in catch ng birds

level Overcrowding poor ventilation the presence of lice and mites and other factors may cause birds to cease production or lay at a reduced rate

CATCHING AND HANDLING THE BIRDS

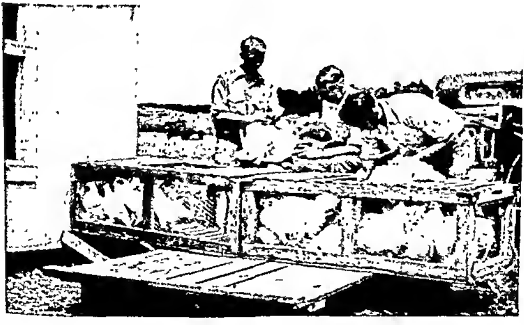
The poultry flock if it could be caught as easily as a cow or horse would be culled more often than it is now The easiest and most satisfactory way of catching a flock of birds is by the use of a catching crate as is shown in the illustration at the bottom of page 107 The crate should be used at an exit door or in a doorway between pens The birds will go into the crate much more readily if they have been used to going in and out of the exit or doorway

In case a catching crate is not available it is usually possible to pen off a small enclosure in one corner of the chicken house by the use of a section of closely woven wire fence The birds should be handled in such a way as not to frighten them or piling and smothering may result After the hens are driven into an enclosure one person goes inside and catches the birds one at a time and hands them out either over the top of the



Courtesy L. M. Hurd

A section of stiff wire, 5 feet high and 20 feet long, makes an excellent enclosure in which to catch birds inside the poultry house.



The portable catching crate, with sliding ends and top, is useful for handling birds on range or in culling.

wire or through a hole made in the wire at a convenient height Unless the wire is stiff and heavy strips of wood should be fastened at the bottom to prevent the birds from crawling out underneath

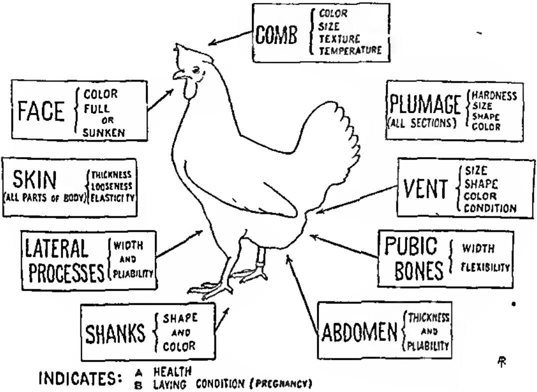
In small pens and where only a few birds are to be handled they may be caught off the floor by the use of a hook or a catching net The common type of hook and net used for this purpose is shown on page 105 This is not a satisfactory method of catching a large flock of birds because they are chased too much in an effort to capture them Also the hook may bruise or injure the leg when the bird struggles to escape

In removing the bird from the catching crate the wings may be grasped close to the body and the bird lifted from the crate head first The bird should not be grasped by one leg and pulled from the crate In holding the bird for examination the keel bone of the bird should rest on the palm of the hand (the hand used will depend on whether the culler is right or left handed) with the head of the bird toward the culler s body The legs are grasped at the hock joints by the fingers of the hand in which the bird is being held At least one finger should be kept between the thighs of the fowl in order to prevent rubbing of the hock joints The base of the thumb may be used as a support to the bird in order to prevent it from tipping sideways The bird is comfortable in this position and there is no danger of injury The culler always has one free hand with which the wing may be spread out for examination or with which the various parts of the body may be examined The culler should handle each bird noting all the points that may be used in culling before making a decision It is seldom safe to use one character alone in deciding whether to discard a bird or hold for a longer period

CHARACTERS INDICATING LAYING CONDITION

Comb wattles and ear lobes It is a simple matter to tell whether a pullet or hen is in production There is a close relationship between the condition of the secondary sexual characters—the comb wattles and ear lobes—and the activity of the primary sexual organ—the ovary During a period of two to three weeks before a pullet lays her first egg there is a tremendous change in all of these characters The increase in

PHYSICAL CONDITION
(APPEARANCE AND HANDLING QUALITY) AS A FACTOR IN JUDGING POULTRY



Characters indicating present laying condition and handling quality.

the size of the mass of the developing yolks and ovary may be several hundred per cent while at the same time this change is reflected in the comb, wattles, and ear lobes by marked expansion and in the case of the comb and wattles by a bright-red color and a waxy appearance. The red color of the ear lobes is apparent only in breeds with red ear lobes. This activity is accompanied by an increased supply of blood and rapid circulation. It has been shown that the amount of blood in a laying hen is approximately 20 per cent greater than of a hen in a dormant condition.

The hen may be considered a factory, the feed being the raw materials and the egg the finished product. The chain of events leading up to the process of egg production apparently begins in the pituitary gland, located at the base of the brain. This gland secretes a hormone which gets into the blood and

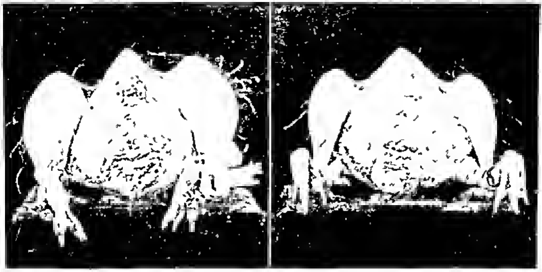
The large comb and wattles would indicate that this pullet is laying.

This bird at the age of five months was a normal female. At the time the photograph was taken she had developed distinct male characteristics.

is transported to the ovary, where it acts as a stimulator in setting the ovary to work in the production of yolks. The ovary in turn becomes a gland of internal secretion and produces a hormone that causes the development of the oviduct, which is necessary in the making of a complete egg. This process continues as long as the bird stays in production.

With the medium- to large-combed breeds, such as Leghorns, Anconas, and Minorcas, the comb is a remarkable indicator of the laying condition of the fowl. The same changes take place in the smaller-combed breeds but are somewhat more difficult to recognize. As production continues through the year, the comb contracts and expands according to the bird's blood supply and the activity of the reproductive organs.

As the bird passes from a laying to a dormant condition, the size of the comb, the wattles, and the ear lobes decreases and they become shriveled and dry, and pale in color. In the language of the poultryman, the bird is simply sending out a signal that she is closing the factory for a rest, and now is the time to send her to market. Abnormalities, such as internal laying, or a diseased ovary may cause a bird to have the appearance of laying at all times of the year, but other indications will show that she is not in laying condition.



The bird on the left was not laying. The skin over the abdomen is tight, the vent is small, and the pubic bones are close together. The bird on the right was in heavy laying condition. Notice the large size of the vent, the soft flexible skin over the abdomen, and the widespread pubic bones.

Vent. The vent serves as the common opening of both the digestive and reproductive systems of the fowl. The vent of a laying hen is large, moist, and dilated, and tends to become crescent-shaped. The lower edge appears flat and extends almost straight across, while the upper edge of the vent forms a semicircle, which blends into the loose, pliable tissue surrounding it. Contrasted with this is the small, dry, contracted vent of the hen in a dormant condition. The edges of the vent are drawn in and present a wrinkled appearance. The region around the vent is puckered, rough, and dry.

These characters, usually referred to as physiological characters, indicate current laying condition only and cannot be used to estimate past production or to forecast future production.

PIGMENTATION

The culler has two useful guides which he may use in determining how long a hen has been in production: pigmentation and plumage changes, or molt. Pigmentation refers to the yellow color deposited in the fat of the yellow-skinned varieties. It is evident in all visible parts of the healthy pullet before production has commenced and is usually present in cockerels at all times. Pigmentation can be used most effectively as a

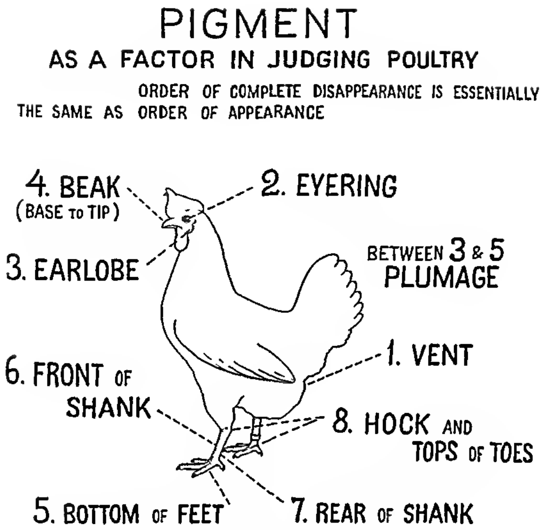
guide during the winter, spring and early summer but is less effective in fall culling because so many of the heavy laying birds become entirely bleached by that time On the other hand, molt is of little value except during the fall molting season These two characters indicating the length of the laying period may be used together effectively, always giving at least one reliable guide at any time of the year Pigment is used largely to estimate past production

This yellow color is present in yellow corn and in green clovers, alfalfa, and grasses and it is from these and other feeds that the reserve supply is built up in the body of a healthy bird Hence the intensity of yellow color in the pullets will depend upon the supply of these feeds in the ration of the growing stock as well as on the vitality of the bird itself The low-vitality bird, as a rule, will not carry so deep a pigment color as will the high vitality bird

When the normal pullet begins to lay she gradually becomes bleached in the visible parts of the body apparently because of the diverting of the yellow pigment, which is associated with fat deposition in the body, through the blood to the ovary where it is deposited in the yolks of eggs Since the supply of fat and pigment is no longer available for deposition and replacement in the body tissues the pigment already present in the tissues is lost by oxidation through the outer layers of skin This loss of yellow pigment is usually referred to as bleaching

Order of bleaching The color changes appear to take place most rapidly where the circulation of the blood is greatest or where the colored tissues are softest They take place in all parts of the body at the same time, but the difference in the rate of withdrawal or oxidation of the pigment in the fat from the different sections of the body causes certain parts to become entirely bleached more quickly than other parts The order of becoming entirely bleached, as shown in the chart on page 113, is however, the same in all birds

Vent The tissue surrounding the vent of the laying hen is usually first to bleach, presumably because of its rapid expansion with the beginning of production Occasionally by the time the first egg is laid, a large part of the yellow color around the vent has disappeared This is due to the fact that yolk



The order of complete disappearance of yellow pigment.

formation begins about ten days to two weeks previous to the actual laying of the first egg. During this time many yolks are partly formed. In general, the vent will become white by the time from six to eight eggs have been laid and, after a long period of heavy production, the vent becomes bluish white and often shows a bruised appearance.

Eye ring. The eye ring, or edge of the eyelid, being thin and also well supplied with blood, is the next to bleach. This condition usually will be evident after nine to ten eggs have been laid. For the beginner in culling, this character is often hard to see because of the redness of the face of the bird, hence it is not so important as some other characters. Also, changes in

the eye ring take place so close to the time that similar changes take place around the vent that it may be unnecessary to use this character except for very minute distinctions

Ear lobes This color character can be applied only to a few breeds having white ear lobes such as the Leghorns and the Anconas Since breeds such as the Plymouth Rocks, the Rhode Island Reds and the Wyandottes have red ear lobes, the disappearance of the yellow color is not visible there. Under ordinary conditions the ear lobe bleaches after from ten to fifteen eggs have been laid Where this character can be used, it is of considerable value because of its prominence

Beak The blood circulation in the beak appears to be considerably slower than in the vent, the eye ring, and the ear lobe, and hence the bleaching is not so rapid The base of the beak, that is, the portion attached to the head, becomes bleached first and the yellow color gradually disappears from the base toward the end the end of the upper mandible being the last portion of the beak to bleach The lower mandible fades more rapidly than the upper mandible, and as a result there is often a trace of yellow pigment on the curved tip of the upper mandible but none on the lower

The relation of the degree of bleach to the number of eggs produced was studied at the experimental farm at Cornell University The results of one series of observations on Single-Comb White Leghorn pullets were as follows to bleach the beak one third white, 11 0 eggs, to bleach the beak one half white, 19 0 eggs to bleach the beak two-thirds white, 23 3 eggs, to bleach the beak four fifths white, 29 1 eggs, to bleach the beak all white, 35 5 eggs The pullets in this experiment were housed, fed, and managed under normal conditions They had green food daily, twelve hours of illumination, and the Cornell ration

One should not mistake the reddish color often found in the beak of Rhode Island Reds for yellow pigment This horn color does not fade out

Shanks The shanks, because the color changes here are very slow, are valuable indicators of long periods of production The yellow color becomes entirely bleached on the front of the shank before it does on the other parts of the shank. The bottom of the foot also bleaches about as rapidly as does the

front of the shank. The back of the shanks and the tops of the toes lose color more slowly and are still yellow when the front of the shanks becomes white The last trace of yellow color may be found either on the hock joint close to the feathers or on the rough heavy scales on the top of the joint at the at tachment of the foot to the shank After a considerable period of production no one part of the shank will give the original pigment color of the bird Naturally those sections holding color the longest will most closely resemble the original pigment color The time required, or the total continuous production required, to entirely bleach the shanks is variable The most commonly accepted time is from four to six months of pro duction, depending on the intensity of that production, the natural recuperative power of the bird, and the management the bird has received Some large, vigorous birds properly fed to maintain their body weight may lay 200 or more eggs before their shanks are bleached Such breeds as Barred Plym outh Rocks or Anconas may not show the disappearance of the yellow pigment so clearly as will White Leghorns because of the presence of dark spots or a greenish color in the shanks

Return of yellow pigment When the ovary ceases to de velop new yolks and production stops, the fat globules which were going into the formation of the yolks are again available for deposition underneath the skin of the bird As this deposi tion of fat takes place, a yellowish cast is again taken on The order in which various parts of the body yellow up again is exactly the same as the order of fading, namely, the vent, the eye ring, the ear lobes, the beak, and lastly the shanks The return is much more rapid than the disappearance

Disturbing factors These color changes, as regards both the fading and the return of the yellow color, are variable in dif ferent individuals A part of this variability can be accounted for by the various factors which cause differences in the rate of bleaching, and hence a consideration of these factors is es sential to obtain reasonably accurate results from culling work The most important conditions influencing pigmentation are the feed, the size and vitality of the bird, and the coarseness of the skin

Feed Birds fed on a ration containing a large amount of yellow corn will not bleach so rapidly as will birds fed on white

corn or a ration containing only a small amount of yellow corn Birds allowed plenty of green grass range will not bleach so fast as will birds kept confined all of the time This difference is due to the increased amount of yellow pigment taken into the body through the digestive system Birds may also begin to store up pigment if the amount of grain is increased or if they are turned out on range When one goes into a flock to cull and finds that the beaks of most of the birds are yellowing up slightly at the base, he should ascertain, as far as he is able to do so what changes have been made in the management or the feeding As a rule, when a bird does take in pigment following some change in the pigment supply, the intensity of the color deposited is not deep as compared with the intensity of the pigment color following a complete cessation of production

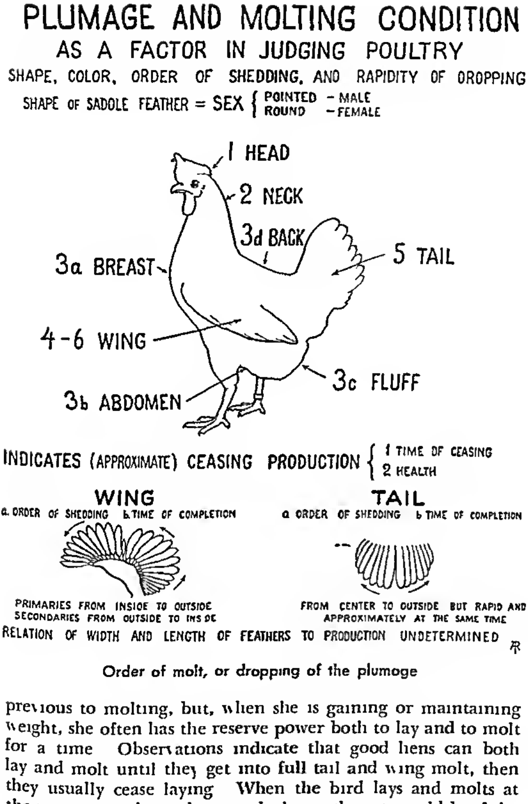
Size of the bird As a rule the larger bird bleaches more slowly Poultrymen find that the American breeds bleach more slowly than Leghorns and that large Leghorns bleach more slowly than small Leghorns

Thickness or coarseness of the skin The coarse, thick-skinned bird is thought to bleach less rapidly than the thin, soft skinned bird This difference probably is due to the fact that the coarse skinned bird is carrying more fat underneath the skin, and hence a larger amount of time is required in which to use up this supply of fat

Disease The presence of disease will often cause a loss of pigment in the different body parts even though the bird is not laying

PLUMAGE CHANGES (MOLT)

As a natural habit every hen drops her old plumage and grows a new coat of feathers annually This growth of a new coat of feathers requires a large amount of food material, hence only the very best hens can continue to lay after they have started to molt The low producing hen rarely lays and molts at the same time, but often the high producer continues to lay for several weeks after starting to molt, provided she is maintaining or gaining weight A bird generally ceases to produce when, regardless of her production quality, she begins to molt and has been losing weight during her production period



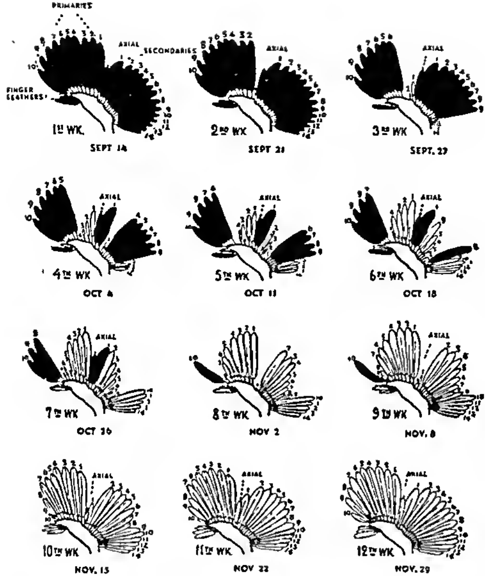
Order of molt, or dropping of the plumage

previous to molting, but, when she is gaining or maintaining weight, she often has the reserve power both to lay and to molt for a time Observations indicate that good hens can both lay and molt until they get into full tail and wing molt, then they usually cease laying When the bird lays and molts at the same time, the molt is much slower than it would be if she were not laying, but the production does not slow up materially.

Much has been said concerning the time that early molting and late molting hens come back into production following their molt Observations by several different investigators prove rather conclusively that October and November molters kept under normal conditions will complete their molt and come back into production just as soon as do the July and August molters If the early molting hens are segregated and given special management they may be brought back into production much earlier than they will come back normally if left in the regular flock It is evident then that the longer the fall molt on all of the birds can be delayed the higher will be the average annual egg production It is just as important, however not to go to the other extreme and delay molt so late in the fall that the birds do not have time to get their new coat started before cold weather sets in The normal rest period appears to require from two to three months

The order of molt of the different feather sections in the case of the hen is very regular but the order of completion varies The order in which the various parts of the body plumage begins to drop is as follows first the head followed by the neck the breast the fluff the thighs and the back Then the wing molt starts and at the same time or a little later the tail molt begins The tail feathers however are completely renewed several weeks before the wing feathers This order is shown in the chart on page 117 A small amount of molt may take place on the head during the winter and spring months but little molt occurs elsewhere without a marked effect on the production of the birds

The order of molt in the wing is regular The wing is divided into definite sections as shown in the chart on page 117 The two large sections are divided by a small feather called the axial feather The primary feather which is next to the axial feather is first to drop and the other primary feathers drop out in regular order the outermost feather being last to drop in the case of a normal complete molt in the wing In the case of the secondary wing feathers the order is not so regular yet it is consistently the same in all birds The secondary feathers nearest the body of the bird that is the tenth to the fourteenth feathers (counting from the axial feathers) are the first to drop Then the molt begins with the second second



The weekly changes in a normal wing molt. The solid portions represent the old feathers, while the new ones are represented by the feather outlines.

ary feather and works toward the body in regular order. Following the ninth feather, the first secondary and axial feathers are dropped. The order of molt in Plymouth Rocks, Rhode Island Reds, and New Hampshires is essentially the same as in Leghorns, but it may not be so regular. The actual molt and growth of new feathers taking place from week to week is shown in the picture above.

There is apparently no distinct difference between the rate of growth of primary wing feathers of the same length in low

and high producers but there is a marked difference in the rate of the dropping of the primary feathers in the two groups especially when allowance is made for eggs laid during the molting period The low producer inasmuch as she does not come back into production after the molt any earlier than does the high producer has a much longer time in which to molt and hence takes about a two-week period between the dropping of each primary feather On the other hand the high producer having a much shorter time in which to molt on the average will drop a primary feather about every nine or ten days The net time in molt or the time of combined molt and production deducted from the length of time in molt is six or seven days for each feather

In determining the length of time that a hen has been molting one must know how long it takes (1) to grow a new feather as well as (2) the time that lapses between the dropping of the feathers Actual measurements of the primary feathers at weekly intervals during their growth period indicate that new feathers require from six to eight weeks to grow in completely About 95 per cent of the actual length of the feather is however grown at the end of the six weeks the remainder of the growing being mainly increase in width with only a slight increase in length About 60 per cent of the actual feather length is grown during the first three weeks of growth The only means of telling how long a time has elapsed between the dropping of individual primary feathers is the difference in length of successive feathers Since the primary feathers drop in regular order one may obtain a fair idea of the period between the dropping of these feathers by comparing one with the other as to length

Very often some feeding or management condition causes a hen to go through a summer vacation molt during which time from one to several primary feathers are dropped When a bird after going through such a molt and coming back into production again for a time begins her regular fall molt she starts where she left off with her summer vacation molt dropping the next primary feather following the last one dropped in her previous vacation molt She molts the remainder of her primaries in regular order and then begins again with Number 1 primary or the one next to the axial feather and

drops over again those primary feathers which had been dropped during the vacation molt. This performance happens only in case of a summer molt. A late fall or early winter molt in the case of pullets beginning to lay very early in the fall does not affect the order of molt the following fall.

CULL TO PROTECT THE HEALTH OF THE FLOCK

A hen must be in perfect health to lay at her best. It follows, then, that only those birds are profitable which are healthy. This is sufficient reason for culling.

There is a second reason for culling such birds. By so doing, a source of disease is being removed from the poultry flock. The culled birds may serve a useful purpose. Submitting them to a laboratory for diagnosis may possibly prevent an impending outbreak of disease. Such information also serves to keep the poultryman informed of his progress in eliminating certain disorders like the avian leucosis complex through a progeny-testing program.

WHAT SHOULD BE CULLED

The avian leucosis complex is responsible for a large share of the culls and deaths in laying stock. The complex takes many forms, and all birds showing signs of any form should be culled promptly. For example, a condition characterized by large, distended abdomens, commonly called "water bellies," is caused by an accumulation of fluid in the body cavity usually resulting from a tumor of the liver (big-liver disease). Birds with partial or complete paralysis of the legs, wings, or neck suffer most often from the nerve form of the complex—fowl paralysis. Sometimes the only symptom is that of a halting, stilted gait. Often the only result of such nerve involvement is a badly emaciated bird. The ocular form of the complex more commonly known as "gray eye" or "pearl eye," produces partial or complete blindness. The abnormal actions of such birds usually attract the poultryman's attention. The eye becomes an opaque white, and the pupil, instead of being perfectly round, is irregular in outline. It should be remembered that many birds have normal eyes of a gray color. These birds should not be culled.

Pendulous crops in birds can be detected by the greatly

distended low hanging crop Such birds go out of production and become progressively thinner Treatment of these crops rarely results in a permanent cure Cull these birds

The strain of laying often causes an eversion of the cloaca or a blowout Recovery seldom is permanent It is best to cull blowouts at once

Bumblefoot an infection of the foot pad, results in a marked swelling and consequent lameness Treatment of such birds is usually not worth while They should be culled

Egg laying troubles are responsible for many cull birds Unfortunately there are no typical symptoms which can give one a clue to the cause Most often these birds simply become dumpy go off feed and either remain on the roost or stand huddled by themselves A few of the conditions that may be found are impacted oviducts broken egg yolks and internal eggs Briefly any bird that has any visible abnormality does not belong in your flock

For ordinary farm flock or commercial flock culling the physiological characters which have been discussed are all that are necessary Head type and body type are useful chiefly in the selection of breeders

SELECTING PULLETS

It is a common practice among farmers and commercial poultrymen to rear each year more pullets than will be needed to fill the available housing space The problem of the selection of the best pullets results from this procedure The practice is an excellent one if the poultryman will stop selecting when his houses are full but the natural tendency is to keep on crowding the houses as long as good pullets are available This often results in overcrowded conditions in the laying house Such conditions may further result in an epidemic of the common fall and winter diseases such as colds roup bronchitis and chicken pox which might have been avoided if the houses had not been overcrowded

The selection of pullets is much more difficult than the selection of hens which have gone through one laying year In the case of pullets that have been laying for some time it is past production that is being estimated There are certain physical characters such as pigment molt and physical condition which

is actively mating with hens or is confined away from the hens, except his actions Such characters as pigment, molt, and physical changes are therefore of little value in estimating the ability of a male to produce pullets that will lay well, except as changes may affect the health and vigor of an individual male There are, however, a number of characters commonly associated with males bred for high producing ability

Masculinity. The first character that a male should possess above all others is masculinity An effeminate male is of little value as a breeder Masculinity is shown by the rate of maturity, both sexual and body maturity, in much the same manner as a pullet as far as external characters are concerned Early crowing, an aggressive nature, a vigorous constitution, gallantry, attitude to females, and frequency of mating are all indicative of masculinity Masculinity can hardly be separated from vigor, for a bird without vigor is very likely to be weak from the standpoint of masculinity Masculine birds may, however, be out of condition temporarily due to improper feeding or housing, to disease, or to freezing of the combs, wattles, or ear lobes, but they may recover During the time that such males are out of condition they are of little value as breeders The ultimate aim in the selection of males is almost always for breeding purposes, and to be an efficient breeder a male must be in the best physical condition possible at all times while in the breeding pens Barred Plymouth Rock cockerels of high and low constitutional vigor are shown in the illustration on page 126

Defects The statement has often been made that "the male is half of the flock," and, since this statement is true, very great care should be exercised in selecting males for breeding purposes Fortunately since nature has provided a large number of males to select from and since the ratio of males to females is close to one to one, many more males are produced than are used as breeders Males should be as free from all breed defects and disqualifications as possible One poor male may do twenty times as much damage in a well bred strain of birds as one female in a single season by the introduction of some undesirable character Every poultryman should know the standard defects and disqualifications of his particular variety or varieties of chickens and should always use males as free from

A pullet that is low in flesh at the time she is ready to lay unless very carefully managed will not remain in production long and may not start at the time she should begin production

In the case of pullets with yellow pigment the pigment may be used as a good index to the physical condition A pullet when ready to lay should have an abundance of yellow pigment in all sections of the body Xanthophyll pigment is associated with the fat and an abundance of the yellow pigment indicates good physical condition The presence of pigment cannot be used to predict future production except as it may affect the health or the physical condition of a pullet Molt is of little value in predicting how many eggs a pullet will lay, but it is very useful in estimating recent past production and present laying condition

Head and body type In general the same types of heads and bodies will be found in pullets as in hens and the same relations will exist with respect to production qualities Temperament and nervous energy in a pullet may be determined by head type expression of the eye, and the actions of the bird while being handled A nervous active energetic temperament is generally characteristic of both pullets and hens which make high records The nervous disposition is not flighty but is quick thinking, curious and friendly

Since there are fewer characters to be used in the judging of pullets than in that of hens judgment will not be so accurate and many pullets will be placed in the laying house or will be trap-nested that will prove to be less productive than anticipated This is often due to the fact that inheritance plays a very important part in the number of eggs a hen will lay in one year

The prospective high producing pullet must conform to the general requirements of body type of a hen that has laid heavily The body type of a pullet changes so materially and rapidly as it approaches the laying period that it is difficult to judge pullets accurately until they have actually begun to lay

SELECTING MALES

The selection of males for egg production qualities is more difficult than either the selection of pullets or mature hens There are no apparent physical changes in a male, whether he

the *American Standard of Perfection* are in most cases very satisfactory for production males. A vigorous male of good-production type is shown in the illustration on page 70.

Pedigree. Where possible, the pedigree of a male should be used together with the physical characters as a basis of selection. The average annual egg records of the daughters of a cock from different females can be used as a measure of his breeding ability with a good deal of certainty. Pedigrees, however, should never be used alone in placing judgment on a breeding male.

SUGGESTIONS AND QUESTIONS

1. Make a survey among flock owners in a community, and obtain the number who make a practice of culling the pullet flock at the time of housing. If the information can be secured determine whether the success of the poultry enterprise is in any way related to the practice of culling pullets at the time of housing.

2. Explain why one handling of the laying flock each year for purposes of culling is not a satisfactory procedure.

3. List all the factors which may have a bearing on the amount of culling in any particular flock of birds.

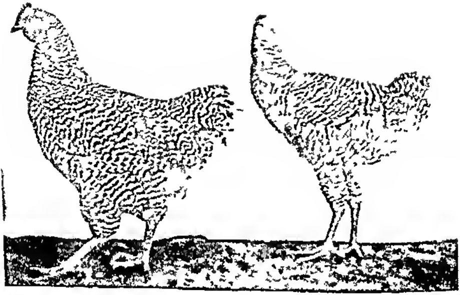
4. Using the information given in Table 16, and with the cooperation of two or three poultrymen in a community, have a group of students cull the flocks and check their results in order to see if they can raise the number of eggs produced by 100 hens by the use of proper culling methods.

5. Have the students, as a laboratory project, examine two hens, one in full laying condition and the other dormant, and carefully compare the external characters of the two birds. Kill them and open the body cavity. Move the digestive organs to one side and compare the ovaries and oviducts of the two birds. Remove the two organs from each bird and weigh them. Do the external characters correctly reflect the condition and activity of the internal reproductive organs?

6. As a class project make a catching crate and catching frame. Have each student make a catching hook.

7. A flock of birds has many individuals in it that have areas on the head, neck, and abdomen that are free of feathers. Is there any way of deciding whether or not these birds are molting?

8. If hens with trap-nest records can be secured, test the powers of observation of the members of the class by having each student first decide whether or not the hen is laying and if not decide how



The cockerel on the left shows vigor and a well-developed body. The one on the right is long-legged and shows poor body development

these defects as possible Time and care spent in the selection of males is a sound investment

Head and body type. The head, as in the selecting of females, is the best single character to be used in the selection of males The secondary sexual characters—comb, wattles, and ear lobes—reflect the activity of the primary sex organs It has been found that in cockerels a close relationship exists between the size and the color of the comb, the wattles, and the ear lobes, and the size of the testes The head also indicates masculinity, health, and vigor Fineness of quality is indicated by the texture of the comb, the wattles, and the skin on the face

The body of the male, like most other animals, is more massive throughout the whole anterior, or front, portion than in the posterior, or rear, region The condition is reversed in the females when in heavy laying condition There are no apparent changes in the abdominal region of a male as described in the case of the female. Size is a very important factor in judging and selecting males The standard weights given in

CHAPTER 5

Housing the Flock

THE STUDY of poultry housing is important for two major reasons (1) the results obtained with a flock of chickens may be determined to a considerable extent by the environment in which the birds are kept, and (2) a large part of the investment in a poultry enterprise is in buildings. Chickens are affected by both high and low temperatures, and if they are to produce to the best advantage they must be protected from heat, cold, rain, snow, wind, and sudden changes in temperature. This means that the type of houses to be provided will vary considerably with the area of the country in which the farm is located. A house suitable for southern California would not be satisfactory for New England. The basic principles of housing are the same, however, regardless of the location. The primary question concerns the details of construction.

ESSENTIALS OF A POULTRY HOUSE

Comfort for the hens. The first point to consider in housing the flock is the comfort of the chickens. Temperature is the most important, although humidity, air movement (freedom from drafts), space, convenience, and cleanliness should be considered. Maximum production is usually experienced under natural conditions with temperatures between 50° F and 70° F, but experiments with artificial heat during the winter have given better results at temperatures of 45° F. to 50° F., and excellent production is obtained at lower temperatures. Experimental work does not show that it pays to heat laying

long the hen has been out of production This can be done by reading the primary feathers of the wing and checking with the pigment and laying condition

9 Write a short discussion on the relationship of culling and mortality

10 Explain why it is more difficult to cull males than hens

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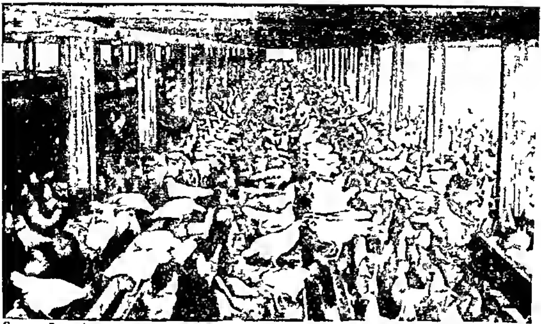


Courtesy Pennsylvania State College

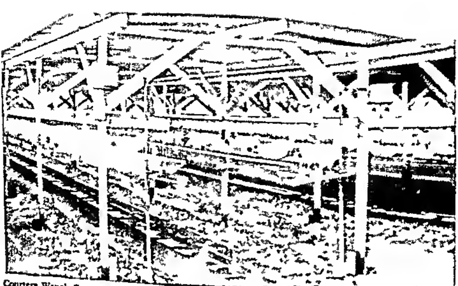
Seventy-five hundred laying pullets in one flock Notice the arrangement of the feeders and watering equipment. The perches are three tiers high.

perature and help prevent rapid decreases in production. Where temperatures reach 90° F, the heavy breeds are apt to decrease in production, whereas the White Leghorns stand the heat better and are not markedly affected until temperatures of 100° F. are reached.

Little information is available relative to the effect of humidity upon production and the health of the birds. A reasonably dry house and litter are justified, however, from the standpoint of the saving of labor in cleaning eggs and the preservation of the building.

Poultry houses should be free from drafts or rapid air movement in the colder months of the year, because such air movement is a factor in the presence of respiratory troubles in the flock.

Give the hens enough room. The results one gets with a flock of laying hens can often be related to the number of birds in a given area. Overcrowding encourages cannibalism, causes difficulty in keeping the litter dry, and prevents the less aggressive birds from obtaining feed and water. But the space allowed a bird increases the housing cost and therefore has to be limited. Experience and some research work have shown



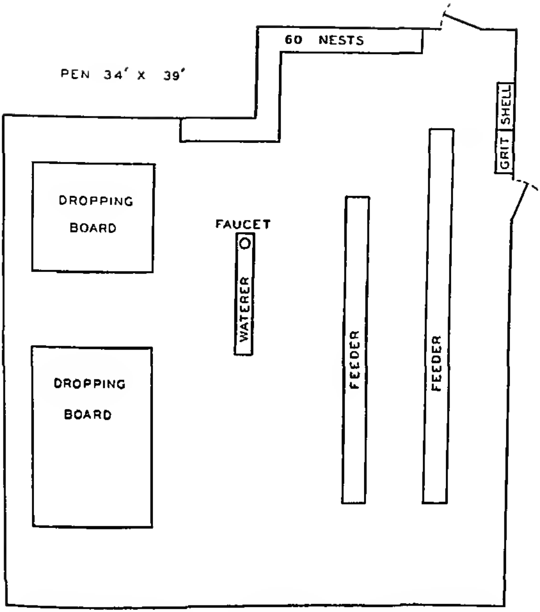
Courtesy Waugh Company

Open air hen batteries used in warm, dry climates They can also be used for pullets approaching maturity Similar two tier units are also used

houses under most conditions When temperatures get below 15° F, the combs of the birds are likely to freeze, resulting in a drop in production The actual temperature at which production is reduced by cold weather is determined by breed (heavy breeds are more resistant to cold and more susceptible to high temperatures than are Leghorns and other light breeds), humidity, rate of temperature drop, rate of production, and the physical condition of the birds

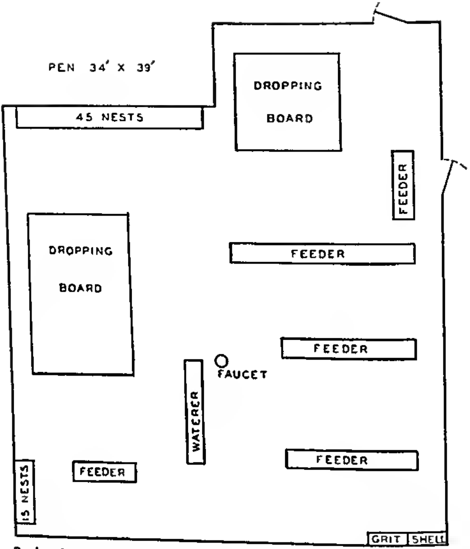
As the temperature decreases, food consumption increases so that the bird can maintain its body temperature When the temperature reaches 10° F to 15° F, however, the birds become inactive and feed consumption drops, as does egg production Undoubtedly where the birds are not acclimated to lower temperatures, lower production will result even at temperatures of 20° F to 25° F

High temperatures can also adversely affect production, but usually it is impractical to attempt to hold the temperature of the house much lower than the air temperature outdoors by mechanical air conditioning Insulation of the ceiling use of reflective paint on the roof, and cooling by evaporation of water from the roof may make a few degrees difference in tem



This is a revision of the floor plan on page 132. It is possible to save labor and time required for feeding and watering poultry and for gathering eggs by rearranging the equipment, often with little or no expense.

The nests should be close together and near the door. Running water and drains should be provided. Feed storage should be in the same building. Studies have shown that feeding, gathering eggs, and watering account for most of the time spent with the poultry flock since these tasks have to be done at least once and usually several times a day. Studies have been made showing variability in the amount of time and miles per year



Poultry house floor plan showing inefficient arrangement of equipment (See opposite page for revised plan)

that light breeds such as Leghorns require less space than the heavy breeds The general recommendations in square feet per bird where they are kept confined are shown in Table 17

Convenience for the caretaker. The primary objective in housing poultry is to provide for the comfort of the birds In terms of economic production, however, the poultry house must be convenient for the poultryman The layout of the pens should be figured carefully so as to reduce labor and steps

TABLE 18 Miles of Travel in a Year in Caring for 1,000 Hens

Job	Farm Number								Average 8 Farms
	1	3	2	6	5	7	4	8	
Feeding									
Dry mash	31	*	*	29	37	46	115	87	43
Wet mash		26	40	59		23	41		24
Pellets			42				46	58	18
Grain	27	53	36	71	146	81	99	56	71
Grass								123	15
Total feeding	58	79	118	159	183	150	301	324	171
Watering	8		2	73	98	199		3	48
Gathering eggs	44	71	85	108	111	72	154	202	106
Open and close nests				36			4		5
Other	1		1	10	9		1	6	4
Total, all chores	111	150	206	386	401	421	460	535	334

* Mash hoppers had been filled the day before
(From study in progress at New York State College of Agriculture)

TABLE 19 Hours in a Year Spent on Chores for 1,000 Hens

Job	Farm Number								Average 8 Farms
	1	3	2	6	5	7	4	8	
Feeding									
Dry mash	23	*	*	45	31	54	202	115	59
Wet mash		43	33	63		33	47		28
Pellets			33				44	62	17
Grain	30	36	40	102	99	59	88	67	65
Grass								71	9
Total feeding	53	79	106	210	130	146	381	315	178
Watering	8		4	163	90	211		28	63
Gathering eggs	62	212	201	155	160	117	217	299	178
Open and close nests				101			6		13
Other	2	5	3	13	11		10	28	9
Total, all chores	125	296	314	642	391	474	614	670	441

* Mash hoppers had been filled the day before
(From study in progress at New York State College of Agriculture)

TABLE 17 SPACE REQUIREMENTS FOR HENS

Number of Birds in Pen	Square Feet per Bird	
	Leghorns	Heavy Breeds
1 50	5	6
51 125	3½	4
126 300	3	3½
301 up	2½	3

required to do chores with poultry (Tables 18 and 19) The figures have been converted to a 1 000 hen basis

Economy of construction A satisfactory poultry house need not be expensive to construct Likewise expensive poultry houses are not always satisfactory since an economical house may have more of the essentials of a good house than a poorly designed expensive one Cost account studies in various parts of the United States have shown that on the average one third of the investment in a poultry enterprise including the residence is in housing There seems to be little or no relationship between the cost of a house and the results obtained in production and mortality It is poor economy however to use poor quality materials and workmanship A well-constructed poultry house should last thirty years or more A good foundation and roof are particularly worth while investments

CLASSIFYING THE HOUSE

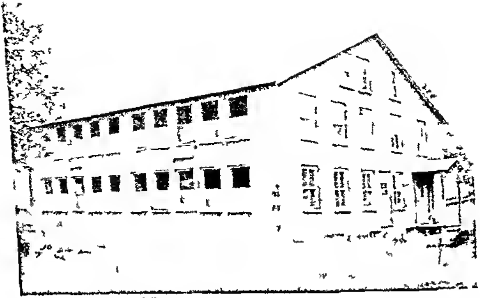
Poultry houses may be classified in a number of ways (1) by purpose for which they are to be used (2) by size (3) by portability and (4) by number of floors Actually practically all houses fall into two or more of these classifications since the first classification covers the purpose and the second gives the type of construction For example a brooder house is either permanent or portable It also may be a single deck or a multiple deck house Generally speaking we classify a house so far as the purpose is concerned by whether it is used for brooding for rearing or for laying or breeding flocks Then to some extent each one of these groups can be broken down further as follows If it is used for brooding is the floor or battery *system* to be used? Rearing houses may be range shelters or

colony houses or possibly large permanent units where the birds are reared in confinement Laying houses are designed for use of batteries or for birds on the floor Breeding units are used either for large flock matings in which case they are the same as a laying unit, or as small individual breeding pens for ten to twenty birds

The question of portability of the house is used primarily in reference to the brooding house and the rearing house In other words, it is no longer a common practice in this country to use portable houses for any other purpose, although it is still a general practice in England and other European countries where labor costs are not so important Portable houses cost practically as much as permanent houses but the depreciation and labor involved are somewhat greater, so that from the standpoint of keeping production costs low, the portable unit, except for brooding and rearing, is no longer considered

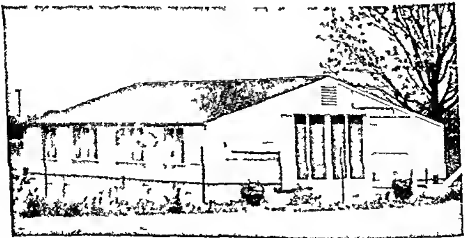
The size and the style of the house do receive a great deal of attention There is a decided trend toward larger poultry houses for this type of building is more economical to construct, easier to ventilate, and reduces the labor required for caring for the birds The majority of the poultry houses built ten to twenty years ago were 20 to 24 feet wide, usually were single deck, and in most cases had a shed roof Today large poultry farms have houses 30 to 60 feet wide, they are often two to four stories high and several hundred feet or more long However, there is some question as to the economy of building a house which will handle more than 6 000 birds This is about the maximum number one man can handle with present methods and the danger of increased fire loss is great where larger units are used These large houses usually have a flat or gable roof, but gambrel roofs are used also

In a few cases circular houses have been constructed, since the more nearly round a house is the less the exposed surface per square foot of floor space Most poultrymen, however, prefer a square or rectangular unit which is more economical to construct than a round house and can more easily be increased in size As an example of the difference in the amount of floor space per square foot of exposed area, the illustration on page 138 shows the comparable figures for a round, a square, and a long narrow rectangular house in which the total floor



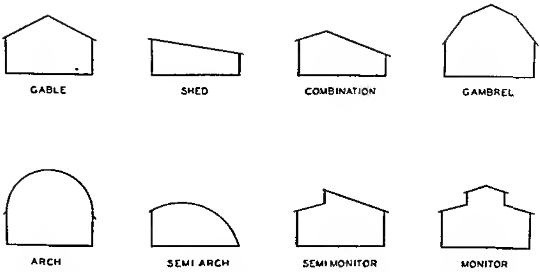
Courtesy Pennsylvania State College

Cinder block poultry buildings are popular. The outside should be covered with a waterproof material since the cinder block absorbs water readily.



Courtesy Purdue University

A modern farm poultry house. The house is 30 by 30 feet but can be built in any length desired. In locating this house keep in mind the possibility that it may be desirable to add to it eventually.

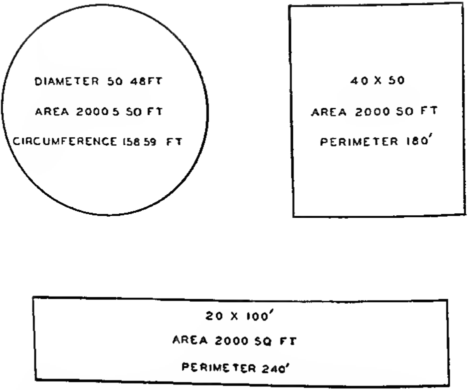


Roof designs used on poultry buildings. The shed, gable, and combination are the most common.

take care of a three-story, 30-by-100-foot house containing 9,000 square feet. It is true that the latter type house would require heavier foundation and possibly heavier studs for the wall construction. In spite of this, it is probable that the multiple-deck house could be built somewhat cheaper than a comparable single-story house containing the same number of square feet.

Just as styles have changed in poultry-house construction, so the style of roof used on poultry houses has changed. Poultry books of forty or fifty years ago show a large number of monitor- or semimonitor-style roofs. Today this is practically unheard of except in very warm areas, and the common practice is to use a shed roof for shallow houses up to 18 or 20 feet deep and to use a gable, combination, or flat roof for deeper houses. The cost of maintenance on roofs of the latter types is apprcciably lower than for a shed-roof house. Occasionally poultry houses are constructed using the Gothic- or gambrel-type roof, but this practice is not common.

The important points to consider in a roof are the first cost and the cost of maintenance. It is probable that a gable-type roof has a slightly higher first cost than a flat roof, although if well-made, built-up roofing is used on a flat roof the costs are not far apart. Under practically all circumstances the gable roof will have lower maintenance charges, since a good wood shingle or asphalt shingle will have a life of twenty to thirty years.



The shape of the house is a factor to consider when building A round one is economical to construct but cannot be increased in size readily A long narrow house requires more material and is apt to be difficult to ventilate A house that is nearly square is economical to construct, easier to ventilate, and can be added to readily

area is the same for all three Obviously there would be differences in the construction and heating costs of these three types of houses

Many poultrymen particularly in the eastern part of the United States favor the multiple decked house, that is, the house with two three, or even four floors In the Middle West and on the West Coast, the preference is for single story houses Unfortunately there are no comparable figures showing the differences in the costs of construction of these two types of houses nor studies concerning the relative labor efficiency of the two styles A multiple decked house is generally more economical to construct inasmuch as the foundation and roof that would serve a single story 30 by 100 foot house containing 3 000 square feet for a very slight addition in cost will

roads In locating a permanent brooder house or a colony house, consideration should be given the distance from nearest adult birds It is highly desirable, as is pointed out in the section on brooding, that the young birds be isolated from mature chickens

Poultry houses not more than 24 feet in depth usually face the south, southeast, or the east depending on the prevailing winds This permits the winter sunshine to enter the house and give adequate light If the house is 30 feet or more deep, however, the general practice is to have the long axis of the house run north and south so that the light is more evenly distributed throughout the day

In a few instances poultry houses, particularly permanent brooder houses, are being built without windows because a house of this type is more economical to construct and has less heat loss Mechanical ventilation by electric fans is commonly used, although in the winter natural ventilation by means of intakes and flues will work This will be discussed in the section on ventilation This type of house calls for a very efficient forced ventilation system during the summer months, and many times the cost of this system will offset the saving in the cost of constructing the original building without windows This style of house is not common but does offer opportunity for use, particularly for permanent brooding during the cooler months of the year The direction that a windowless house must face would be immaterial except that the door should be on the side away from the prevailing wind

VENTILATION ESSENTIALS

Poultrymen in general give as much thought to ventilation of poultry houses as to almost any other single housing factor This is true because during the winter they can see the effects of poor ventilation in wet litter condensation and frost on the walls and ceiling of the house, and the odor of ammonia in the house Many times these effects are not necessarily due to poor ventilation but can be attributed to poor construction of the building overcrowding leakage of watering equipment, and snow and rain blowing through openings

With a few exceptions, wet litter has been a troublesome

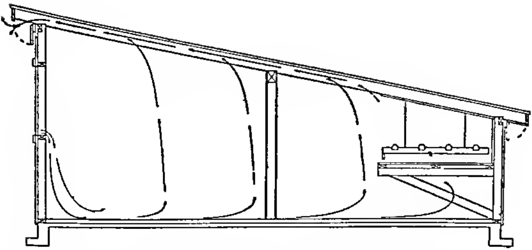
The geographic location of the house itself should also be considered and most engineers prefer the gable roof where the snow load is apt to be considerable If the flat roof is used under these conditions then it should be constructed of heavy material well supported by posts so that there is no danger of collapse because of the weight of the snow The gable roof also has the advantage of providing storage space for feed bins straw shavings and so forth at relatively little addition in cost whereas if a flat roof is used extra space has to be provided for these in the house itself

LOCATION OF THE POULTRY HOUSE

If one should make a tour of the poultry farms of the United States he would find poultry houses in all sorts of locations from high on a mountain to a low spot in a valley The location of the house however should be given serious consideration

So far as the site is concerned the house should be placed on well-drained land where natural drainage is away from the building The preferred location is on a south slope in order to take advantage of sunshine and at the same time to protect the house from the prevailing winter winds which are usually from the north and northwest From the standpoint of construction level land simplifies the problem of foundation construction and grading but advantage can be taken of land slopes so as to permit access to the second or even the third floor of the house for the purpose of unloading feed and moving birds and litter A windbreak or some protection from the prevailing winter winds is desirable but it should not be close enough to the house to restrict sunshine and air flow If one has a choice of placing a house on top of a hill at the bottom or part way down the slope the latter location is to be preferred because of better water and air drainage

From the standpoint of nearness to other buildings the poultry house should be close enough to the farmhouse to offer some protection from thievery as well as to decrease the amount of time spent in going to and from the house It should be far enough from the other buildings to reduce the danger of spread of fire from one building to the other Consideration also has to be given to the necessity of water supply electricity and



Air movement in a shed roof, rafter ventilated house with the curtain closed and with the birds on the floor

This is the so called rafter ventilation or slot ventilation system The illustration above shows this action The third important factor making it possible to ventilate poultry houses by natural means is the temperature differential between the indoors and the outdoors It is a very important one, the importance of which is directly proportionate to the temperature differences It is a commonly known fact that warm air is lighter than cold air and tends to rise or is pushed up by the cold air falling to the floor A one degree Fahrenheit change causes a change in the volume of air about 1 490 or an increase in volume of air in a 500 cubic foot unit of approximately one cubic foot

By designing a ventilation system which makes use of these facts it is possible to satisfactorily ventilate a poultry house by natural means

In order to have a ventilation system, inlets and outlets are necessary In general, these should have a comparable area, but it is quite important that the inlets be small and well distributed, whereas the outlets should be large While the most common method of ventilating poultry houses is to use a so-called open front house where a large curtain is adjusted upward or downward to close or open, in reality this is not a ventilation system Where weather conditions are mild, it will serve the purpose, but where low temperatures are experienced during the winter months, it generally is not satisfactory

problem to poultrymen for many years Improved ventilation systems have helped correct a considerable amount of this difficulty but the extended use of built up litter has solved it for many more

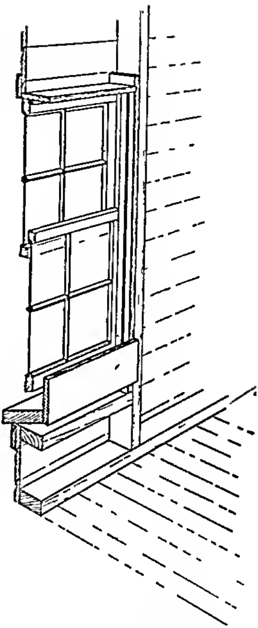
In reality ventilation calls for much more than the mere removal of moisture from the poultry house Among the factors to be considered in designing a ventilation system are (1) the question of air supply that is the actual maintenance of the oxygen content of the air by removal of carbon dioxide and other waste products (2) the air temperature (3) relative humidity (4) air motion (5) air distribution and (6) removal of odors If a definition of ventilation is called for possibly this might do The process of introducing fresh air into a building in sufficient quantities without draft removing the products of respiration and maintaining the air at a certain healthful standard

Natural ventilation Several methods are used to move air in poultry buildings The most common method and the one in greatest use in poultry buildings has depended on natural physical laws The three motive powers involved are (1) the wind pressure on the intake cracks around the windows around the door and leakage through the walls (2) the suction on the leeward side of the building through various openings (3) the temperature difference between the air indoors and the air outdoors

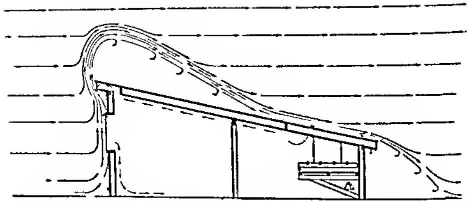
Wind pressure on the intake is difficult to determine but definite data on the size of the intake and the location have been worked out as will be shown later in the chapter In general we can say that in order to reduce the possibility of draft intakes should be small with an area of not more than 60 square inches each they should be well distributed around the building and it should be possible to close them The effect of wind suction is very important in exhausting the air from the building Ventilation systems are designed to take advantage of this and the best demonstration is the effect of air blowing across the top of a flue or chimney This reduces the pressure at that point and tends to draw air from the flue to fill the low pressure area Thus an air movement is set up which helps ventilate the building The same effect is evident where the outlet of the poultry house is located along the upper plate of the shed roof

through fairly rapidly If the air is moved as rapidly through the insulated house, much of the benefit of the insulation will be lost

In installing a flue system special attention must be given to the size, number, and distribution of the intakes If desired, double hung windows baffled so as to prevent drafts to the floor, can be used, but it is usually more satisfactory to construct special intakes The outlet should preferably be near the center of the building with the flue extending through the roof for several feet The height of this flue will be determined by whether or not it is protected by nearby buildings or trees If it is protected, it will have to be somewhat higher than otherwise If the flue goes through an unheated portion of the building, for example, the loft in a gable roof house, it should be well insulated However, if it goes through a warm area such as another pen, as in a double deck poultry house, or if the flue extends to the floor, this portion need not be insulated, although it is desirable In reality this flue is a chimney through which flows a column of warm air which tends to rise owing to the pressure of the cold air behind it The movement through the flue is also accelerated by the suction of the wind across the top of the flue One flue should be provided for each pen unit If two are installed



A window intake for a brooder or laying house The window should be screened by using a hinged frame rather than by nailing the wire to the studding



A rafter ventilation system will work even though the wind blows directly into the front of the house The low pressure area created at the peak draws the air from the house

The rafter or slotted front ventilation system has given reasonable satisfaction particularly where the house is uninsulated It works well in single story shed roof houses but is not so satisfactory in other types The picture above shows the system in operation The air moves through the house partly because of the wind pressure on the intake partly because of the suction of the outlets and partly because of temperature differences If there is no temperature difference the movement will be extremely slow and will depend on only two of the three factors This system is not so well adapted to the insulated house not because it does not ventilate the house well but because it does not conserve heat In any poultry house ventilation system one of the essentials is the conservation of the heat given off by the birds

Another popular ventilation system is the flue system This depends upon the same principles as does the rafter ventilation system but will work under more varied conditions This system is popular in dairy barns as well as in poultry houses In determining the type of flue system to use in a house one major factor to consider is whether or not the house is insulated If the house is insulated the flue should extend within 18 inches of the floor if uninsulated the opening of the flue should be at the ceiling The primary difference here again is the problem of conservation of heat In an uninsulated house there is little heat to conserve since most of it will be lost through the ceiling and walls therefore the air might as well be moved

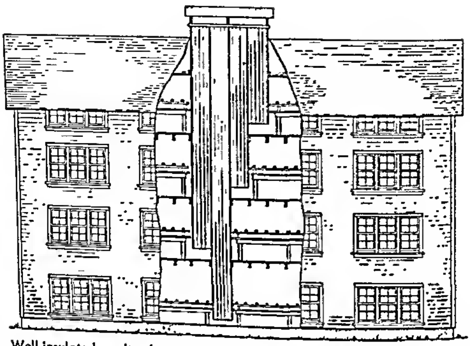
in a single room, one of them may serve as an intake and cause a strong downdraft while the air is going upward and out through the other This downdraft is undesirable If the pen is large, with a wire partition through the middle of it forming two pens, then one flue will serve both pens If the partition is solid, two flues, each a little more than half the size of the flue for the double pen would be required

The flues should be placed at as great a distance as possible from the intake, and the vertical distance between the intake and the outlet should be as large as possible For example, if the flue comes within 18 inches of the floor, then the intake should be located at a height of 5 or 6 feet above the floor On the other hand, if the flue is at the ceiling, then the intake should be located nearer the floor, possibly 2 to 3 feet above it The warm house with a floor flue tends to have a slower circulation of air than does the cold house with a ceiling flue There is a constant movement of air within the house, since warm air is rising and cold air is falling This cold air comes in contact with the birds and is warmed by the heat given off by them so that it rises, and thus a circulation is set up in the house which tends to make the temperature more uniform At the same time, a certain percentage of air is being replaced by fresh air coming in through the intake and air being drawn off by the outlet Table 20 gives the area required for the intake and outlet for houses of various sizes The same table is used for both insulated and uninsulated houses

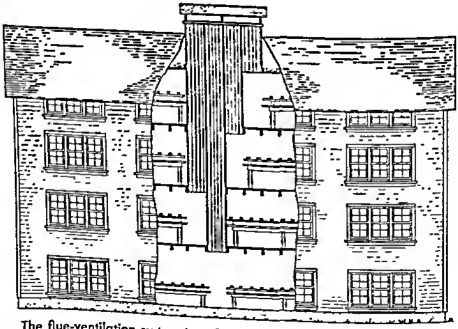
TABLE 20 Size of Ventilating Flues for Various Floor Areas

Floor Area of Pen	Size of Outlet Flue	Inlet Flues
Square Feet	*Inches*	*Each 60 Square Inches in Area*
less than 540	16 × 16	4
540–614	16 × 18	5
615–684	18 × 18	5
685–759	18 × 20	6
760–839	20 × 20	7
840–924	20 × 22	7
925 1009	22 × 22	8
1010–1104	22 × 24	9
1105 1200	24 × 24	10

Forced ventilation No ventilation system using natural forces is satisfactory under all conditions, since the results are



Well-insulated poultry houses equipped with flues should have the flues extend to within 15 to 18 inches of the floor. This will conserve heat and still provide adequate ventilation.



The flue-ventilation system in a four-story uninsulated poultry house.

in the previous system One method of installing a fan is shown in the illustration on page 150

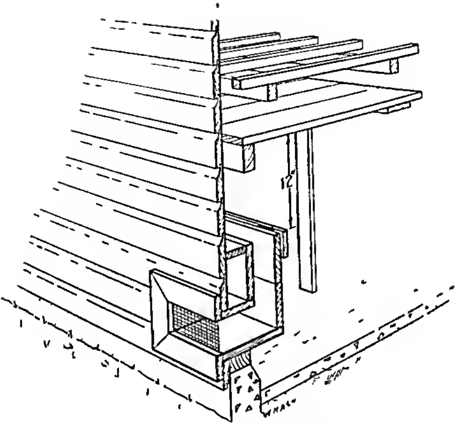
Table 21 shows the size of the fan ducts and inlets which should be used in houses of different areas An ordinary electric fan such as is used to remove air from a kitchen is not satisfactory for poultry house ventilation Because of dust, these fans have a very short life under the extreme conditions experienced in the poultry building A completely enclosed fan of the type shown on page 150 is necessary These fans cost appreciably more than do ordinary electric fans but have a much longer life and accordingly the annual cost is much less The cost of operating an electric fan to ventilate the poultry house during the winter months is very low

TABLE 21 SIZE OF FAN AND DUCTS FOR VENTILATING VARIOUS FLOOR AREAS

FLOOR AREA	FAN DELIVERY	APPROXIMATE FAN DIAMETER	SIZE OF DUCT	NUMBER OF INTAKES
Square Feet	*Cubic Feet per Minute*	*Inches*	*Inches*	*Each 60 Square Inches in Area*
400	270	9–10	12 × 12	2
800	540	9–10	12 × 14	3
1200	800	12	15 × 16	5
1800	1200	12	18 × 20	7
2700	1800	14	20 × 24	11

While the discussion has been applied primarily to houses for laying hens the same principles apply to ventilation of permanent brooder houses In ventilation of portable brooder houses using oil or coal stoves, there is no particular problem since the stove itself serves as a ventilating unit It is continually drawing in air and exhausting it through the flue Some provision should be made for admitting air, but the ordinary brooder house has quite a bit of leakage around the doors and windows and the windows can be provided with deflectors and serve as intakes

During the summer months free circulation of air in the poultry house is very desirable Most areas in the country experience high temperatures for varying lengths of time and unless air movement is ample throughout the house the birds may be affected by heat prostration For this reason it is desirable to have openings on at least two sides of the house even though the



An intake located under the droppings board The total area should not exceed 60 square inches A wire guard can be placed over the inside to prevent the birds from perching on the ventilator

determined by several forces To meet this situation many poultrymen are converting to forced ventilation by means of electric fans There are several methods of using fans for ventilation, but the same principle would apply relative to suction of the air as in the flue ventilated house If the house is insulated, the better method is to exhaust the air from the floor by means of a flue If it is uninsulated, the air can be removed from the ceiling, although floor flues will also work reasonably well The intakes should be small in size and well spread throughout the house so as to bring fresh air in small quantities throughout the area without drafts It is also possible to recirculate the air through the house by means of electric fans and exhaust only part of the air instead of removing all of it as

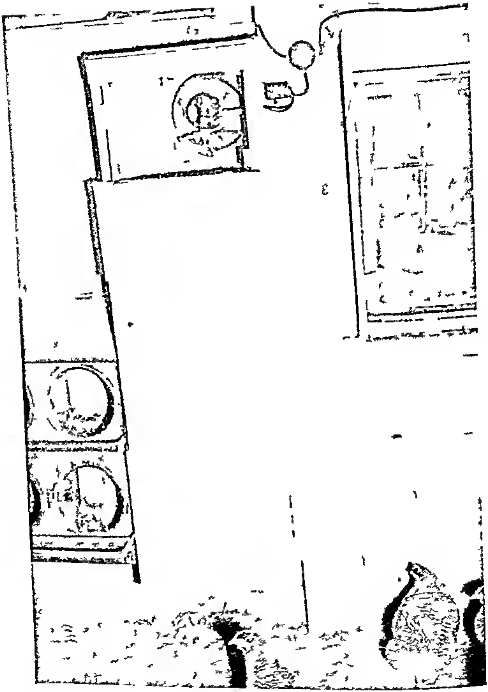
ones in the rear of the house may not be so large as those in the front. In the colder areas of the country, openings will be such that glass or glass-substitute windows can be placed in them during the winter months and completely removed in the summer. In deep houses of 30 feet or more the practice is to have an equal number of windows in both front and back. Where much hot weather is experienced, the windows should be very large. In the southern part of the country, where cold is no problem, openings are covered only with wire screen the year round, although cloth or canvas curtains should be available to be rolled down under unusual conditions.

BUILDING DETAILS

Foundations and floors. Concrete foundations are recommended for all permanent poultry buildings. Footings should be at least a foot below the ground in the warmer areas and several feet in the cold areas. If the building is of tile, cinder or concrete block, or poured concrete, the footing of the foundation wall should go below the frost line since heaving will crack the walls. In the case of a frame building, which is more flexible, it will stand a certain amount of stress. These footings are usually at least 6 to 8 inches wider than the foundation which is to rest on them. (A drain tile should be laid around the base of the footing at the time the footing is laid.) The foundation should be 6 inches wide for a one-story house and at least 8 inches wide for a two-story building, should extend 6 to 10 inches above the floor level. Anchor bolts should be installed when the concrete is poured, so that the sills of the buildings can be firmly attached in the foundation.

If wooden floors are to be used on the first floor of the building, vents should be provided in the foundation so as to permit some air circulation underneath the floor. In a few areas, houses are built on posts or piers. This is not satisfactory where cold weather is experienced.

A smooth, hard floor is very desirable in a poultry house. While dirt or tamped clay can be used for temporary buildings, over a period of years it is apt to be more expensive than a concrete floor because of the rat problem and the difficulty of cleaning. Probably concrete is the best material for ground-level floors. A good fill should be used under the concrete, prefer-



An electric fan used in conjunction with a flue in an insulated house The door permits oil ng and inspection of the fan and can be used for summer vent lot on

asphalt compound is often used to cement one layer to the other In reality this is a low cost, built up roof, and while it costs more than the ordinary roofing, it will have a much longer life For houses using gable or combination roofs, asphalt or wood shingles are recommended because of their long life For a flat roof the only type that is satisfactory is the built up one Instructions on the installation can be obtained from various manufacturers of the products used in its construction

Windows. Windows in poultry houses serve two purposes to provide light and to provide ventilation The space allowed depends upon the geographic section of the country where the house is located In a warm climate the area of the openings can be large since summer ventilation is relatively more important Where winters are cold the amount of space should be as small as is practical and still provide adequate winter light and summer ventilation A small area is desirable since the heat loss is excessive through any type of glass, cloth, or glass substitute A good ratio for northern areas is 1 square foot of window space to 25 or 30 square feet of floor space In warm areas a ratio of 1 12 is better

The location of the windows depends upon the size of the house and the direction it faces Houses 30 feet or more in width should have windows well spaced on all sides Narrow houses usually have most of the windows in front but with a few in the rear This provides better distribution of light and permits cross ventilation during the warm weather If the windows are concentrated on one side of the house as they are apt to be in narrow houses they are usually located on the south side to take maximum advantage of winter sunshine

Glass pane windows are commonly used, but glass substitutes, such as the cellulose acetate products, are very useful This type of product permits the passage of some of the antirachitic light rays from the sun, whereas ordinary window glass does not

Walls and ceilings The material used in making the walls will depend upon the availability and price Wood is by far the most common and is probably as satisfactory as any material that can be used Its main disadvantage is that it has to be painted at frequent intervals if its good appearance and long life is to be maintained Cinder blocks are being used to an

ably of gravel or broken stone at least 6 to 8 inches thick al though cinders are satisfactory if they are not in contact with the water pipes After the fill has been well tamped a 2 to 4 inch layer of concrete is poured over it This should be troweled smooth and sloped toward the floor drain A fall of 1 inch for 10 feet is sufficient A mixture of one part of cement to three of sand and three and one half of gravel will give a long lasting floor Before installing a concrete floor make provision for the water line and drainage line While the custom is to place these in the middle of the house placing them near the front has many advantages Since a well-constructed poultry house has a life of 20 to 40 years it can be anticipated that some trouble will be experienced with water or drainage during that time If the lines are laid under the main house in the concrete they will be very difficult to repair On the other hand if they are placed at the front of the house just outside the foundation it is very simple to make necessary repairs and cleaning

The second and third floors of multiple-deck houses are cus tomarily made of wood preferably double floors with building paper between them Treat these with a good wood preserva tive In a few cases poultrymen have used concrete for second floors with very good results Heavier framing is required The base for the concrete is rough boards covered with building paper A special heavy building paper with wire reinforce ments is also available Concrete made with vermiculite is much lighter than ordinary concrete made with sand and has given satisfactory results It is not so strong however nor does it wear as well as sand gravel concrete

Roofs Types of roofs used on poultry houses have been described previously Because of their ease of construction shed roofs are very popular on houses of 20 feet or less in depth This type of roof is usually too flat for shingle roofing Sheet metal is used quite satisfactorily and will give a long lived roof if laid properly Asphalt roll roofing is satisfactory for tempo rary or short lived buildings but the life is relatively short If this type of material is used it is preferable to use one of the products which allows considerable overlap This new type of roofing comes in the standard 36 inch width but an 18 inch lap is allowed for with the result that one has a double roof over the house Where one roll laps over the other a hot

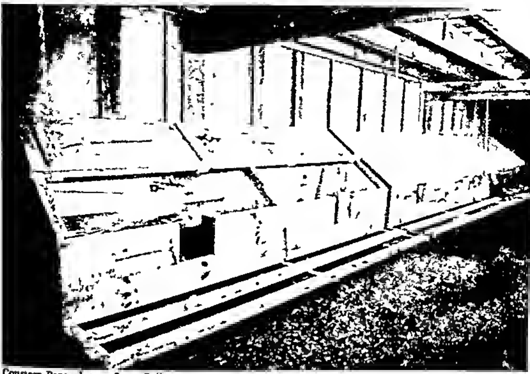
This is due to the greater amount of air in the spaces between the particles There are a number of commercial fill type insulating materials available Used for this purpose are wood pulp, cotton, rock wool, glass wool, and redwood bark Such products as oat hulls, cane pulp straw, and similar materials have insulating properties, but if they settle much of the insulating value is lost This is also true of commercial products

There are various commercial insulating products on the market of the rigid or board type They can be used in place of sheathing on a building and thus serve a two fold purpose As insulation alone they are more expensive than many of the fill types It is a common practice to ceil the inside of a poultry house with this type of material, but it is not recommended since this provides an excellent place for rats to make their hideaways If these products are used for insulation, they should be used as sheathing under the siding or placed between the studs rather than over them The $\frac{7}{16}$ inch products of this type generally available do not have a sufficiently high insulating value to be generally recommended The $\frac{25}{32}$ inch material or the fill insulations are more economical in terms of actual insulation Little heat is given off by a flock of birds relative to the total air space and exposed surface of the house, and considerable insulation is required It is recommended that 50 per cent more insulation be placed in the ceiling than in the sidewalls

Insulation must be kept dry to remain effective, and in order to protect it from condensation a vapor proof paper or material is placed on the warm side of the house Thus in a poultry house the vapor proof material would be on the inward side

EQUIPMENT

Roosts Roosts for the birds are provided in most poultry houses although a few poultrymen keeping heavy breeds have given up the practice and find that they get good results The birds are allowed to roost on the floor In this case, however, the feeders should be on the floor or the birds will use the feeding stands as perches The same applies in the case of nests Either the community type nest must be used or the nests should be shut up every night to prevent the birds from

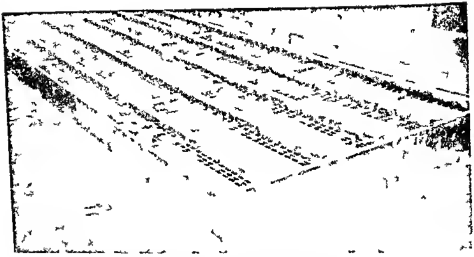

Courtesy Pennsylvania State College

A series of community nests. This style of nest seems to be increasing in popularity because there are fewer dirty eggs produced. A 4-foot section will be adequate for 50 to 60 hens.

from the rear of the house in order to increase ventilation during the summer months. The roosts should be built in sections so that they can be lifted off the dropping board or lifted up to facilitate cleaning.

Dropping pits do not have to be cleaned as often as boards For this reason they are preferred by many poultrymen. However, they have the disadvantage of making a good rat harbor, and, if they are placed on wooden floors, the floor underneath will have a much shorter life. The walls of the pits are usually constructed so that they are easily taken apart to aid cleaning. The roosts are built in a section which is placed on top of the pit, and the pit itself is fastened together at the corners by hooks.

Nests. The location of the nests in the poultry house is more important than the type. The best location for the nests is near the door, since eggs have to be collected two to three times a day, and by having the nests close together at the door considerable time can be saved. If the open-type nest

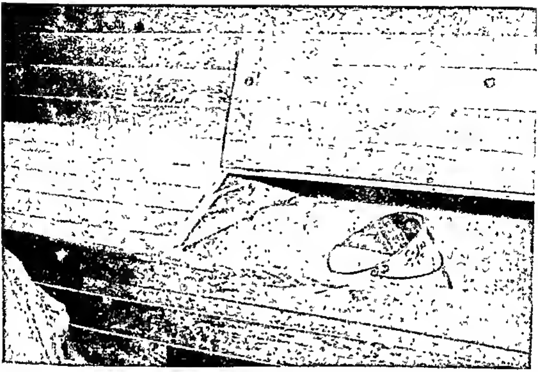


One style of dropping pit in common use Welded 12- or 14 gauge 1 by 2 inch or 1 by 4 inch wire should be used

roosting on them In view of these factors the saving made by omitting the roosts from the house is not appreciable

If roosts are used they can be placed above dropping boards or over pits Each system seems to have its advantages and disadvantages and the individual poultryman will have to make his own decision as to which he prefers Some poultrymen who prefer perches omit both the pits and dropping boards The roosts are customarily located at the rear of the house, although in deep houses they are usually in the center The roosts themselves should be made of 1½ to 2 inch material bevelled on the upper edge and they should be 13 inches to 15 inches apart For light breeds 6 to 8 inches of perch space per bird should be allowed for heavy breeds 10 to 12 inches All the perches and dropping boards or pits should be treated with wood preservative at the time they are installed The height of the perches above the floor is immaterial although low perches are desirable for the heavy breeds

If the roosts are placed over pits or dropping boards keep the birds from having access to the droppings by screening with 1 by 2 inch 14 gauge welded wire One and a half inch hexagonal poultry netting 16 gauge can be used but is not so satisfactory as welded wire The dropping board should be built in table form rather than as part of the house so as to facilitate cleaning and to permit the board to be pulled away



A grain and mash bin inside the laying pen. It is filled from outside the pen. A convenient source of feed saves many steps in a year.

feed bin by means of a chain traveling through the bottom of the trough. The equipment can be homemade or purchased commercially, but its economy is doubtful for small installations.

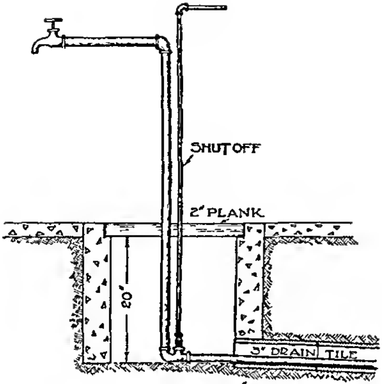
A very important part of the feed unit is the feed storage facilities. In large multiple-deck houses it is common practice to install the storage bins overhead and draw feed off through chutes to each pen. This works particularly well with grain. Where this is not practical, some storage space should be made available in the house itself where bags of feed can be unloaded directly at the house rather than carried from a central feed room some distance away. A storage bin installed in the wall which can be filled from one side and feed drawn off into the pen on the other side, as shown in the illustration above, is quite satisfactory. Where this is not possible, the use of steel barrels to hold a week's supply of grain and mash in the house can save the poultryman many steps during the course of a year.

Waterers. The watering of a poultry flock is an important job which can consume a great deal of time. With the exception of the small portable brooder house, any poultry house

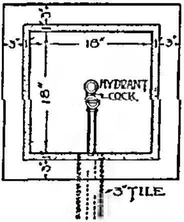
Overhead feed storage bins help reduce labor in feeding

is used it should be approximately 12 to 14 inches wide 14 to 16 inches long and about 14 inches high The front board should be about 6 inches to allow use of plenty of nesting material which in turn helps keep eggs clean One nest should be provided for every 5 or 6 hens Either open front nests or rear entrance nests can be used Community type nests are becoming increasingly popular as poultrymen find that they help in the production of clean eggs These nests are usually 2 feet wide by 4 feet long although they can be constructed in longer units The smaller size is easier to clean One of these nests will serve 50 to 60 hens A separate nesting room located in one corner of the pen is used on some large poultry farms for flocks in units of 500 to 1 000 It has been very satisfactory although it is probable that the use of community nests will make the nesting room unnecessary

Feeding equipment A considerable amount of feeding space is necessary for high producing hens The customary recommendation is to provide 24 to 36 feet of feeding space for 100 hens but even better results are obtained when more than this is provided The hoppers should be large enough to provide feed for the flock for at least one day and several days supply is better The hoppers should be located so as to facilitate feeding it has been found advantageous to place them end to end through the house This saves the caretaker a considerable number of steps when he has to refill them Portions of the feeder can be divided off for the feeding of oystershell limestone grit and hard grit or small individual hopper feeders can be hung from the wall if so desired A recent development on large farms has been the use of automatic feeders where the feed is distributed from a large central



CROSS SECTION



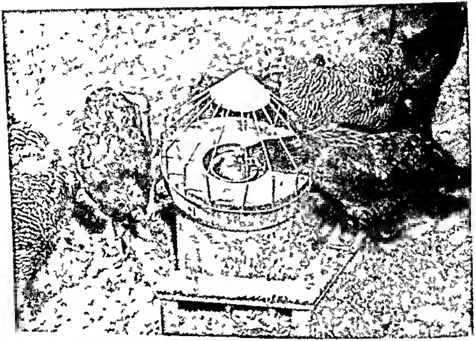
PLAN

A design for a freezeproof water line. The shut-off valve should be of the self-draining type. There are a number of commercial hydrants of a similar design available.

buildings which are already available An old barn, tool house, or other building can often be made into a good poultry house at a third to a half of the cost of a new building The same principles of layout and ventilation apply Many poultry flocks are kept in remodeled buildings with excellent results Under certain conditions changing the system of management will reduce the cost of poultry housing

LAYING SHELTERS

Many poultrymen, particularly in the Northeast are building low cost laying shelters or barracks houses which can be used for about eight months of the year In southern areas these can be used throughout the year These buildings often do not have a concrete floor and are of light construction consisting primarily of a roof with wire side walls They are similar to range shelters except for size Originally they were 24 by 24 feet in size, but many are now being constructed 40 by 100 feet and even larger During the cold weather these side walls can be covered with heavy reinforced building paper, low cost roofing paper or with canvas curtains These buildings are used for birds from about the first of April until November or early December The chicks which are almost invariably one of the heavy breeds are started in November, December, or January in the colony or permanent brooder houses When they no longer require heat they may be placed in range shelters on the range or placed directly in the laying shelters They are kept in production approximately six months and then disposed of before the really cold weather of winter appears This system is used very extensively for the production of hatching eggs for the broiler industry, but it is also quite practical for poultrymen interested primarily in egg production By following this system of management the poultryman has a low investment in his housing he produces eggs at the time of the year when they are highest in price and the labor requirements for his flock are lowest in the spring when other farmwork is most pressing It would seem that this method of management offers fine advantages to the general farmer keeping poultry as a sideline as well as to the large poultryman interested in high production when the returns are the greatest As has been pointed out it is partic



An automatic waterer in operation. This is set over a pit and only in extremely cold weather is it necessary to shut it off or to place an electric heater in the tile.

continuous belt operated by a gasoline or electric motor are also useful This is the same as is used for elevating grain into a storage bin A home garden tractor with a snow plow on the front of it can save a great deal of work in the annual cleaning In many large poultry installations floors are constructed heavily enough so that farm tractors equipped with a bulldozer blade can be used for cleaning

Since labor is the second largest item from the standpoint of expense going into the production of poultry and eggs, a great deal of thought must be given to laying out the poultry house so that it will be convenient to the poultryman Automatic ventilation, running water, and convenient location of feeders and nests all help reduce the work involved in caring for the flock.

One of the major capital expenditures on a poultry farm is the housing. Accordingly every effort should be made to build a satisfactory house at as low a cost as possible Sometimes one of the most worth while things to do is to remodel

and on the perches A unit consisting of two small dishes one set within the other, with one containing concentrated ammonium hydroxide and the other hydrochloric acid, can be used to generate smoke to show the air movement

5 Prepare an exhibit panel showing how electric soil cable or tape can be used in installing a nonfreezing poultry house watering system

6 Obtain the co-operation of a nearby poultryman for a short study of his labor efficiency in caring for a pen of laying hens Draw a floor plan of the house showing the location of all the equipment, water supply, feed supplies, and egg room Find out how many times a day he performs such chores as watering, feeding, and gathering eggs, and determine the distance traveled for each job Draw a new plan with a new arrangement of the equipment and determine whether the distance traveled can be reduced Nests may be relocated near the door, a feed supply placed near or in the pen, running water installed and other changes suggested Possibly the flock owner will be interested enough to actually make some of the suggested changes

7 Design a flock laying house which is more economical than those generally recommended but which would meet the essential requirements of poultry housing

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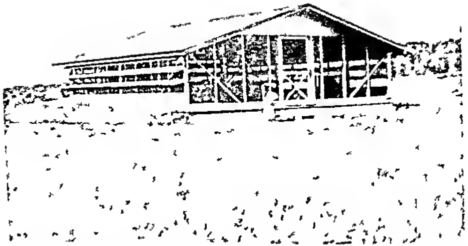


A 24 by 24-foot laying shelter. Covering the front with a glass substitute and wooden panels permits the use of the building the year round There is no great saving in cost, and it would be better to build a poultry house or construct a more economical shelter

ularly useful to the hatching egg producer supplying eggs to hatcheries furnishing chicks for the broiler producer

SUGGESTIONS AND QUESTIONS

1 How well are laying hens housed in your community? Each student should make a record of his home farm and one or two others, indicating the style of the house, the material used, the type of roof and floor the floor space allowed per bird, the ratio of birds per nest, and other items considered in poultry housing On the basis of a number of records comparisons can be made between the standards recommended and the practices actually followed

2 Obtain the co-operation of a nearby farmer and poultryman Select one pen of birds and replace one half of the present nests with community nests Keep records for at least two weeks on the percentage of dirty eggs in each type of nest

3 The construction of a scale model poultry house makes a good class project The house should be of a design and size which would be most suitable for the area

4 A model poultry house can be used to demonstrate the principles of a ventilation system The simplest one is the rafter or slatted front type Small electric bulbs should be installed on the perches and floor, separately controlled so as to show the affect on air movement of the heat given off by the birds when on the floor

water must be given, as only a small part of the requirement for water can be supplied by the feed

Water is necessary for all the body activities It is the medium in which the various bodily processes take place It regulates the body temperature

Very often the water supply is neglected It is just as essential as feed In fact, a hen can live for a longer period without feed than she can without water It is not possible to water her once or twice a day like the larger animals She must have a constant supply of water, for she drinks only a little at a time but very frequently With our present system of dry mash feeding, water must be available whenever feed is available

During freezing weather and where artificial illumination is used, some provision must be made to keep the water from freezing

MINERALS

Minerals are also known as ash, or inorganic matter Only about a dozen are thought to be necessary for the hen s body They enter into the composition of all body tissues Their distribution however, is not uniform, since one finds concentrations of certain minerals in different tissues For example, the bones are a storehouse for minerals especially calcium and phosphorus Iron is concentrated in the blood In the egg the shell is made up largely of calcium On the other hand, the yolk has larger proportions of phosphorus and sulfur

Function The various minerals are intimately bound up with life They help to control the various life processes Mineral starvation of chickens, due either to an actual lack of minerals in the ration or to their unavailability in the system, results in weak limbs and improper bone development A general irritability or excitability and even spasms or convulsions may result from a lack of minerals

Calcium and phosphorus are required in the largest amounts because of their use in bone and egg shell formation These minerals function in conjunction with vitamin D When calcium and phosphorus are not present in sufficient amounts, rickets will develop (See also Vitamin D)

CHAPTER 6

Feed Nutrients and Poultry Feeds

THE FEED NUTRIENTS AND THEIR FUNCTIONS

ALL FEEDS are composed of important groups of ingredients which are called nutrients (Table 22) These nutrients have definite functions or uses in the body Prolonged absence or deficiencies of them will cause a general debility which, if not corrected will result finally in death

Most natural feeds contain all of these nutrients However, no two feeds contain these nutrients in the same proportion Each feed is characterized by containing a larger proportion of one or more of the nutrients This makes it necessary to so adjust the quantities of the different feeds used that the total amount of each nutrient furnished by the ration as a whole will be correct

The feed nutrients and the more important parts they play in the cycle of life are given in Table 23

WATER

Water may comprise from 80 to 90 per cent of green or succulent feeds In kiln-dried feeds the amount of water present may be as low as 5 per cent whereas the grains usually contain from 10 to 12 per cent of water A large proportion of both the body of the fowl and the egg is composed of water, constituting more than one half of the body and two-thirds of the egg Since the body of the laying hen and likewise her product contain more water than solid material, water is an important ingredient of any ration Furthermore, additional

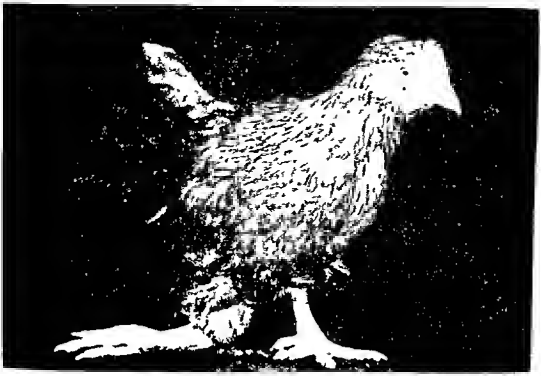
TABLE 22 (CONTINUED)

FEEDSTUFF	MOISTURE	ASH	CRUDE PROTEIN	CARBOHYDRATES Crude Fiber	CARBOHYDRATES Nitrogen Free Extract	FAT OR ETHER EXTRACT	CALCIUM (CA)	PHOSPHORUS (P)	MANGANESE (MN)
	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent	Parts per Million
Feeds of animal origin									
Bone meal, steamed	3 1	73 8	13 0	8	2 8	6 5	28 80	13 34	5
Buttermilk	90 8	8	3 2	0	4 6	6	18	10	Trace
Buttermilk, condensed	71 6	3 5	10 6	0	12 2	2 1	56	33	0 2
Buttermilk, dried	7 1	10 1	33 4	4	44 0	5 0	1 56	1 05	4
Fish meal (average of unidentified fish meals)	8 0	19 7	60 4	7	3 5	7 7	6 50	3 60	45
Fish meal, Menhaden	8 0	20 4	57 5	8	4 1	9 2	*	*	*
Liver meal, Argentine	5 0	5 0	65 4	8	9 8	14 0	11	90	4
Meat scrap (55 per cent protein)	6 7	24 2	55 2	2 2	1 0	10 7	8 25	4 00	18
Meat-and bone scrap (50 per cent protein)	6 0	29 2	50 0	2 1	1 8	10 9	10 20	4 91	10
Skim milk	90 5	7	3 5	0	5 1	2	13	11	Trace
Skim milk, dried	6 0	7 9	35 0	0	50 0	1 1	1 27	96	0 6
Tankage (60 per cent protein)	8 0	19 5	59 8	2 7	1 8	8 2	7 16	3 53	14
Whey, dried	6 3	8 5	12 5	3	71 7	7	83	70	14
Green feeds, etc									
Alfalfa, fresh	73 8	2 5	4 6	7 5	10 7	9	42	07	7
Alfalfa leaf meal	7 8	12 0	20 4	17 1	40 1	2 6	1 90	22	30
Alfalfa meal	8 3	8 7	16 0	27 3	37 2	2 5	1 44	21	26
Cane molasses	24 8	8 2	3 0	0	64 0	0	56	06	*
Yeast, brewers' dried	7 0	7 3	46 5	1 1	35 3	2 8	1 26	1 21	2
Limestone, high calcium	*	*	*	*	*	*	39 20	00	200
Oystershell, washed	*	*	*	*	*	*	38 00	Trace	100

* Information lacking
(*Food and Life*, 1939 Yearbook, U S Department of Agriculture, pp 839–841)

TABLE 22 Average Composition of Common Poultry Feeds

Feedstuff	Moisture	Ash	Crude Protein	Carbohydrates: Crude Fiber	Carbohydrates: Nitrogen-free Extract	Fat or Ether Extract	Calcium (Ca)	Phosphorus (P)	Manganese (Mn)
	Per Cent	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*	*Parts per Million*
Grains and Seeds									
Barley	10.4	2.9	11.8	5.9	66.9	2.1	0.05	0.36	16
Buckwheat	11.9	1.8	10.1	10.4	63.5	2.3	.06	.43	80
Corn	11.9	1.3	9.3	2.1	71.2	1.3	.01	.29	5
Corn meal	11.2	.9	8.8	1.1	75.5	2.5	.01	.30	4
Corn gluten meal	8.9	1.5	43.0	2.6	42.1	1.3	.06	.40	4
Field peas	9.3	3.3	23.3	5.9	57.0	1.2	.08	.40	30
Hominy feed	8.8	2.9	11.0	5.1	65.5	6.7	.03	.51	16
Kafir	11.7	1.6	11.5	2.0	70.1	3.1	.03	.35	16
Linseed meal (old process)	9.4	5.8	35.3	8.5	35.0	6.0	.33	.74	40
Oats	10.1	3.4	11.2	11.3	59.5	4.5	.10	.36	34
Oatmeal, or rolled oats	8.6	2.2	16.2	2.1	64.2	6.7	.08	.44	20
Peanut meal (no hulls) (old process)	6.9	5.6	45.7	9.2	24.0	8.6	.18	.56	*
Rice (whole)	10.3	4.7	7.9	8.8	66.3	2.0	*	*	*
Rye	10.7	2.0	11.5	2.1	72.0	1.7	.05	.36	40
Soybean meal	9.1	5.6	43.9	5.9	30.0	5.5	.29	.69	30
Sunflower seed	7.4	3.4	16.0	28.6	21.4	23.2	.41	.99	*
Wheat	11.0	1.8	12.4	2.4	70.5	1.9	.04	.39	39
Wheat bran	10.2	5.9	15.6	9.0	55.1	4.2	.11	1.21	119
Wheat flour middlings	10.5	3.5	17.0	5.1	59.3	4.6	.07	.69	113
Wheat middlings (standard)	11.1	4.1	16.9	6.6	56.6	4.7	.08	.93	119
Wheat red dog flour	10.2	2.7	16.9	3.2	62.6	4.4	.07	.59	35



Perosis (enlarged hocks or slipped tendons). Notice the flattened hock and the deformed leg.

might not be found in sufficient quantities are sodium, chlorine, calcium, and phosphorus.

How minerals are supplied. The sodium and chlorine are furnished by adding common salt. Usually from ½ to 1 per cent is included in the mash. Calcium for egg-shell formation is best supplied in the carbonate form. Oystershell and limestone grit will furnish this deficiency. Where wheat by-products, meat scraps, and milk are used, there will usually be enough phosphorus. When necessary to supply phosphorus, bone meal, dicalcium phosphate, or defluorinated rock phosphates are usually used.

Manganese might sometimes be lacking in the feed. Small amounts of a manganese salt will supply the needs. A common practice of commercial mixers is to add one quarter pound of manganese sulphate to each ton of mash.

Where minerals are necessary, usually they need to be added only in compartively small quantities. Some are detrimental in large quantities. For instance, with chicks, too much calcium will retard growth and increase mortality. Too much magnesium will upset the birds. An excess of fluorine and

TABLE 23 RELATION OF NUTRIENTS IN FEED TO THE FOWL AND THE EGG

FEED	USE IN FOWL	USE IN EGG
Water	Body fluids and tissues	Water in yolk and albumen
Minerals	Bones Body tissues Blood	Shell Yolk
Proteins	Muscles Blood Nerves Feathers	Albumen Yolk proteins
Carbohydrates Fiber Starch sugar	Energy Heat Body fat	Yolk fat
Fats	Body fat Energy Heat	Yolk fat
Vitamins	Vital organs and functions Enzymes	Yolk Albumen

Other minerals needed in small amounts are also important, as for example, the minor elements manganese and iodine In cases of shortages of these minerals, specific nutritional deficiency conditions develop

Perosis is a nutritional deficiency condition due to a lack of manganese and choline as well as some other vitamins It is sometimes called slipped tendon or "enlarged hock disease" because of the slipping of the tendon and enlargement of the hock which causes crippling of the bird Lameness develops in one leg only, as a rule, because of a twisting and flattening of the hock joint No other symptom of illness occurs Perosis usually appears at three to five weeks of age

Manganese is also necessary for egg production, egg shell strength, and hatchability

A deficiency of iodine in the ration affects the functioning of the thyroid gland, causing an enlargement known as goiter

The ration must contain a suitable inorganic content. The practical poultryman must consider only the minerals that might be deficient in his ration If a good ration, including natural feeding stuffs, is used probably the only minerals that

The protein must also be of correct quality The proteins of various feeds differ because they do not all contain the same amino acids, or if they do contain the same ones, they are not present in the same proportions It is these differences that account for variations in the quality of proteins Furthermore, some of these amino acids seem to be more important than others

Animal protein feeds, such as milk, meat, and fish, are more efficient and valuable than are vegetable protein concentrates The quality of protein is probably one reason for this The animal proteins contain more of the essential amino acids than do the vegetable proteins

The requirement for protein varies for different purposes The growing bird needs more than the mature bird Also, the egg producer requires more than the nonproducer The growing chick needs more protein in early life when it is growing rapidly than it does later or when relative growth slows down Probably there are some differences in the amino acids required

To prevent waste of protein, the various protein feeds must be balanced The most efficient combinations are those that supplement each other's deficiencies This explains why a combination of two proteins may give better results than either one alone When single feeds or a very limited number are relied upon, the results are not desirable unless the choice happens to be a fortunate one in obtaining what is known as a complete protein for the purpose in hand

Undoubtedly the poultryman of the future, with a greater knowledge of proteins, will consider the requirements of a ration from the standpoint of amino acids rather than from the standpoint of the more complex proteins, because it is really the deficiency or lack of any one of these amino acids which will limit results Sometimes an increase in the percentage of total protein has resulted in improvement, not because the animal needed more total protein, but because the amount of a certain amino acid, which was deficient in the small quantity, was increased The same improvement could have been obtained without increasing the total protein by making adjustments in feeds to bring the amount of that particular amino acid up to the necessary level On the other hand, there is

selenium are also detrimental In the body certain minerals are balanced by others and excesses of some might so use up the others as to cause deficiencies Thus it is necessary to practice judgment and precaution in respect to the minerals as much as with the other constituents of the ration The attitude held by some persons namely that the addition of minerals will do no harm even if they do no good is not sound Furthermore the opinion sometimes encountered that if a little mineral is good much should be better is entirely un justified A proper mineral balance must be maintained

In general the use of complex mineral mixtures is not sug gested On the other hand additions of minerals should be specific for definite deficiencies and such minerals should be used singly rather than in combinations

PROTEINS

The proteins consist of a large group of similar compounds which contain nitrogen They make muscular tissue nerves blood and feathers in the fowl and the albumen and other proteins of the egg Protein is a complex nutrient composed of a number of simpler compounds known as *amino acids* More than twenty different amino acids are known The necessary or so-called essential amino acids must appear as such in the feeds because the body in building up proteins cannot substitute one for another

The proteins of different cereals are not of like composition nor are the cereal proteins of the same composition as the proteins of the animal body A single feed protein may not satisfy entirely the needs of the body for protein By com bining the proteins of grains and cereal by products with pro teins from animal sources however it is possible to get a com posite protein that will satisfy the requirement of the body for this nutrient Proteins are not used for energy purposes in the body until there is an excess present

The ration must contain suitable protein This applies to the amount that is present as well as to the nature or quality of the protein It is essential that a certain minimum amount be present in the ration Larger quantities can be used with out actual harm to the bird but their use is not economical since the protein feeds are relatively expensive

cause of a lack of food The greater the number of eggs laid, the larger the amount of food required For a 4 pound hen, not producing eggs, the food consumption averages about 1⅓ pounds a week, or 19 pounds a day for 100 hens The same sized hen with 50 to 60 per cent egg production will require 1⅔ pounds a week and 100 hens will require about 24 pounds a day The art of feeding consists of getting the birds to eat sufficient feed daily

Energy is furnished usually in the form of carbohydrates and fats, which are most economical for this purpose Protein can be used for this purpose when fed in large quantities but it is expensive

VITAMINS

Vitamins are essential for growth, reproduction, and the maintenance of health Formerly, the only method of distinguishing the different vitamins was to observe the effect of rations deficient in one of these nutritive factors on rats, guinea pigs, pigeons, chickens, and other animals Recently, however, several of the vitamins have been isolated by chemical means, and these vitamins now can be distinguished by chemical and physical characteristics as well as by biological and microbiological effects

A number of different vitamins are recognized These have been named by letters, such as vitamins A, B, C, D, E, G, and K Some are still referred to by letter, but in some cases the chemical name is more commonly used The existence of still other vitamins is strongly suspected, as investigators have reported the presence of substances in feedstuffs which are vitamin like in nature and possess characteristics that fail to correspond to those of the known vitamins

Whenever there is a prolonged deficiency of one of the vitamins in the food of animals a nutritional deficiency disease usually develops The symptoms of each disease are characteristic so that an experienced observer has little difficulty in recognizing them

Vitamin A Vitamin A is necessary for maintenance of healthy epithelia in various parts of the body, as in the eyes the respiratory tract and the intestinal tract In vitamin A deficiency the secretions of the tear glands, the salivary glands,

some evidence that increasing one amino acid might make it necessary to increase others in order to maintain a proper balance among them

Until there is more definite information on the quantity and quality of protein needed in poultry rations the safe practice is to use a reasonable variety of feeds in the rations and to depend in part upon animal protein feeds

CARBOHYDRATES

The carbohydrates consist mainly of fiber starch and sugar The fiber is the woody portion or cellulose tissue of plants In the fowl fiber if digested at all is done so only to a slight degree Its chief use seems to be to distend the digestive tract and thereby possibly to aid digestion and elimination

Starch and sugar comprise the more digestible portion of carbohydrates known as *nitrogen free extract* These compounds are used by the body as sources of heat and energy Any excess may be stored in the body as fat The yolk of the egg which is largely fat may be derived from excesses of carbohydrates

FATS

Fats have the same chemical elements as carbohydrates namely carbon hydrogen and oxygen They function the same as carbohydrates in that they serve as a source of heat and energy in the body and of fat in the body and the egg yolk Fats however are so constructed as to liberate more heat upon burning or in digestion They contain approximately two and one fourth times as much heat and energy as do carbohydrates Less is required therefore to serve the same function

Although the available information is not extensive there is some evidence to the effect that the fowl also has a specific requirement for certain of the fatty acids which would then become essential fatty acids

An abundance of fuel is needed to keep the birds working properly that is to furnish energy to keep up body temperature and to supply the body processes The total food or calories consumed is an important factor in egg production Even with a balanced ration production may be limited be

and the mucous glands of the intestinal tract dry up Certain tissues such as the margins of the eyelids, become granular Infection may set in, and when it attacks the eyes a viscous fluid is produced which causes the eyelids to stick together In some animals a white film gathers over the center of the eyeball and blindness results When these symptoms occur, the disease is generally called xerophthalmia Vitamin A is also necessary for normal adaptation of the eye to darkness A low intake of this vitamin results in night blindness

It has been chemically identified but not yet given a chemical name Plants contain precursors that is substances that are transformed into the vitamin in the animal body The pigments carotene and cryptoxanthin are precursors of vitamin A

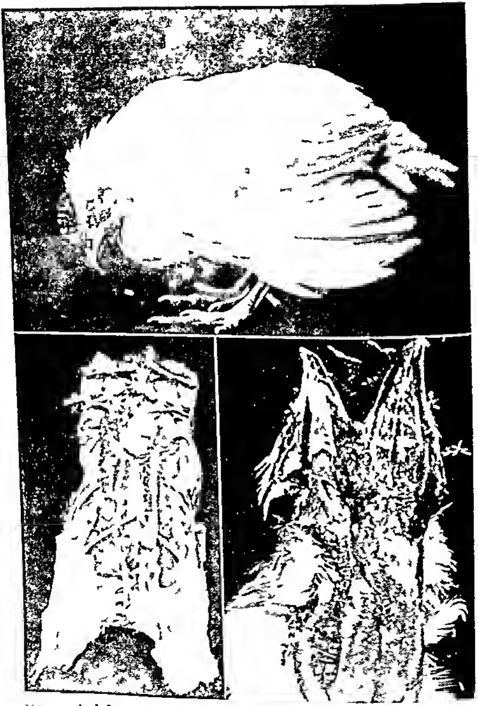
Vitamin A deficiency in poultry is often accompanied by creamy white pustules in the roof of the mouth and along the esophagus Excess urates may be deposited in the kidneys so that these organs enlarge and appear grayish in color The disease is sometimes referred to as nutritional roup because of its similar appearance to roup which is due to other things Afflicted birds walk in a peculiar weaving or zigzag manner and finally are unable to stand After this, death soon occurs

Vitamin B complex The original vitamin, known as vitamin B, has been found to be composed of a fairly large number of vitamins or vitamin like factors This condition has made the terminology confusing Some of these factors have been isolated and recognized, while others are still not so well known

Thiamine Vitamin B_1, known chemically as thiamine, is necessary for maintenance of the appetite and the preservation of the health of nervous tissue Thiamine deficiency results in loss of appetite, emaciation, general weakness and inability to stand frequent convulsions and finally death It is known technically as polyneuritis or beri beri

Because of the wide distribution of this vitamin in cereals the disease is not ordinarily encountered in poultry except in the experimental laboratory

Riboflavin Vitamin G (B_2), known chemically as riboflavin is necessary for the formation of an enzyme present in all living cells It prevents nutritional leg paralysis (curly toe paralysis), or neuromalacia in chicks The distinguishing symptom of nutritional leg paralysis is an inward curling of



Vitamin A deficiency Notice the infected eye (top) the injured kidneys (bottom left), and the pharynx and esophagus studded with pustules in the advanced case shown at the bottom right

factor is required for egg production and maintenance of the health of laying hens than is required for breeders

Pantothenic acid The antidermatosis vitamin, known as pantothenic acid, preserves the health of the skin and spinal cord It prevents chick dermatosis, or pellagra, characterized by scabby lesions on the margins of the eyelids, at the corners of the mouth, and around the vent, and by thickening and fissuring of the skin on the bottoms of the feet The chicks also show an awkward gait, poor feather development, and general weakness Pantothenic acid is also essential for hatchability

Niacin Niacin, or nicotinic acid prevents pellagra in humans and a similar condition in dogs known as "black tongue" It is also necessary for growth and feather development It prevents inflammation of the mouth cavity, esophagus, and crop, a condition similar to black tongue

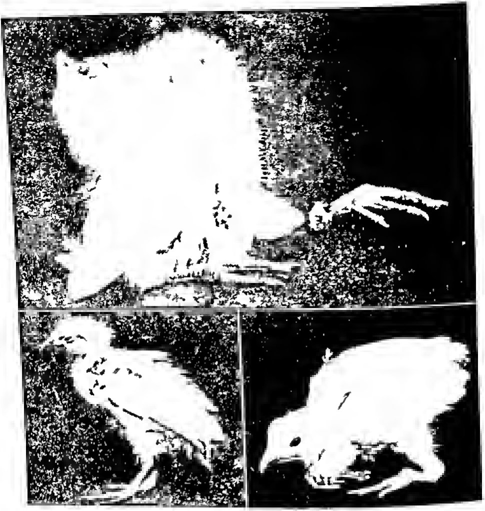
Pyridoxine Vitamin B_6, known chemically as pyridoxine, is necessary for growth and maintenance of appetite Chicks on diets inadequate in this vitamin lose appetite, develop muscular weakness appear emaciated, remain sitting with the head lying on the floor and, before death, develop a convulsion or trembling of the legs and wings

Choline Choline has been reported as being necessary for egg production and the prevention of fatty livers It is also involved with manganese in the prevention of perosis in chicks (See Perosis, page 170)

Biotin Biotin sometimes called vitamin H, has been shown to be necessary for growth and the prevention of a specific dermatosis which is similar to pantothenic acid deficiency in chicks

Folic acid Folic acid, known chemically as pteroylglutamic acid, is necessary for the growth and proper feather development of chicks, the prevention of anemia, weight maintenance, egg production, and hatchability in mature birds In turkeys, it prevents cervical paralysis

Vitamin B_{12} This vitamin appears to be the anti pernicious anemia factor Extremely small amounts have also been shown to be active in promoting chick growth and hatchability It is probably one of the effective factors found in animal protein supplements



Thiamine (B_1) deficiency polyneuritis (top) notice the typical retraction of the head Chick dermatosis or pellagra (bottom left) notice the scabs at the corners of the mouth and eye and on the feet Riboflavin (B_2) deficiency nutritional paralysis (bottom right) notice the position of the hocks with the toes curled inward

the toes with the chick walking upon the sides of the feet rather than the bottom There may be some trembling of the legs The disease ordinarily appears at three to four weeks of age

A lack of riboflavin causes a slowing up in growth or a loss of weight. Riboflavin is required not only for the growth of chicks but also for the growth of chick embryos Hence it helps to prevent failure in hatchability in poultry Less of this

on rations containing no vitamin C for prolonged periods of time without noticeable harmful effects. Yet the vitamin has been found in the liver and kidney of fowls. Presumably then, poultry require vitamin C, but, differing from some animals in this respect, are able to synthesize the amount of vitamin C required.

Gizzard erosions. Notice the crater-like eroded areas on the gizzard lining.

Vitamin D. Vitamin D is necessary for calcium and phosphorus utilization in the body. There are a number of forms of vitamin D. The most common are calciferol (D_2), or activated ergosterol, from plant sources and activated 7-dehydrocholesterol (D_3) from animal sources.

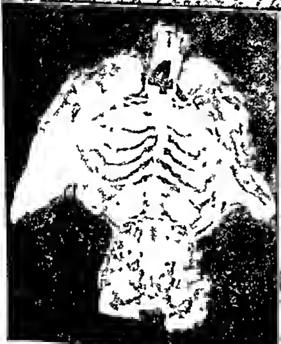
Vitamin D, under those conditions of confinement where exposure to the shorter ultraviolet rays of sunlight cannot be obtained, becomes an essential nutritive factor and is necessary to prevent a type of leg weakness in chicks called rickets. This vitamin-deficiency disease is caused by failure of calcification, or proper bone formation The developing bones do not harden, or they become soft, because in the absence of vitamin D it is impossible to absorb from the intestinal tract the bone-forming mineral elements, calcium and phosphorus, present in the food and to utilize them for bone formation. On account of this, calcium and phosphorus may be removed from the bones in order to carry on other life processes.

In rickets a true lameness develops Chicks are inclined to rest after walking a short distance. The birds walk in a stilted, stiff-legged manner at first but finally are unable to stand. As a rule, little lameness occurs until the chicks are six weeks old. Enlargement of the hock joints, beading of the rib ends, spinal curvature, and crooked breastbones may often be found in rachitic chicks and hens.

Folic-acid deficiency. Cervical paralysis in a turkey (top); poor feathering (bottom).

Vitamin C. Vitamin C, known chemically as ascorbic acid, helps maintain normal blood-vessel walls and keeps the teeth and gums in healthy condition. It also promotes normal healing, particularly in the case of bones. Vitamin C prevents scurvy.

Poultry, however, are not subject to scurvy and have existed



Below: bone formation in absence of vitamin D. Note wide band of cartilage, lack of calcification.

Below: proper bone formation with vitamin D. Notice the narrow band of cartilage and dense calcium deposition.

Vitamin D deficiency. Rickets (top), notice the stiff legged position and initial swelling of the hock joint. Beading of ribs, spinal curvature, and crooked breastbone (bottom left).

A lack of vitamin D also causes failure in hatchability and egg production, and the few eggs laid have thin shells that are easily broken.

Vitamin E. Vitamin E, known chemically as alpha-tocopherol, prevents one type of nutritional sterility. It prevents failure in hatchability and loss of fertility in poultry.

Nutritional encephalomalacia (crazy-chick disease) caused by vitamin-E deficiency. Notice the loss of control of the legs and the head retraction.

It prevents nutritional encephalomalacia in chicks, a disease in which severe degeneration of the brain occurs, resulting in muscular incoordination, inability to stand erect, and spasms followed usually by death. The disease ordinarily occurs between the second and eighth weeks. This condition in the field has been called the "crazy-chick disease."

Vitamin E also prevents muscular dystrophy. It is possible that nutritional myopathy in ducklings and nutritional myopathy in the gizzards of turkeys are due to a lack of this vitamin.

Vitamin-K deficiency. Notice the hemorrhagic areas caused by the failure of blood to clot.

Vitamin K. Vitamin K preserves the clotting power of the blood and thus prevents death by hemorrhage. Its chemical name is 2-methyl-3 phytyl-1, 4 naphthoquinone. Several other similar compounds have also been found active.

Other vitamins and factors. Other vitamins and factors have been shown necessary in poultry diets. Until they are identified their proper classification is not possible.

A water soluble factor, frequently called the animal protein factor because it is generally associated with animal products, is needed for growth and hatchability

Other factors seem to be needed for normal growth and hemoglobin formation

The anti gizzard erosion factor prevents gizzard erosions These appear as "crater like' lesions or eroded areas in the lining of the gizzard as well as roughening of the lining

The ration must contain sufficient vitamins The quantity of any of the different vitamins required by poultry varies with their age and condition Chicks and laying hens undoubtedly have a larger vitamin requirement than do nonproducers Molting hens, however, should not be classed as nonproducers Renewal of feathers should be classed as production the same as growth and the laying of eggs A liberal supply of vitamins must be fed to molters as well as to hens in production

ANTIBIOTICS

One of the most spectacular recent developments in nutrition science is the discovery that antibiotics have growth stimulating properties when fed to chickens, turkeys and swine The finding came as a result of the use of by products from antibiotic production as sources of vitamin B_{12} through recognition that these products at times have greater growth promoting activity than could be attributed to their vitamin B_{12} content. The use of the pure antibiotics such as penicillin aureomycin, terramycin, bacitracin tyrothricin, and streptomycin confirmed the results

The increase in growth rate obtainable by antibiotic feeding varies with the type of animal being greatest for pigs somewhat less for turkeys and least for chickens The differences are greatest in the early growth period and decrease with age Increases in early growth rate as great as 25 per cent have been reported for turkeys the general increase for chickens is about 10 per cent. Failure to differentiate clearly between growth response due to vitamin B_{12} and that due to antibiotics has led in some cases to an exaggerated concept of the antibiotic effect.

Discontinuing the antibiotic during the early growth period results in some depression in growth Less effect of the removal of antibiotics from the feed, insofar as growth is concerned, will

be shown as the birds grow older This is probably related to the fact that the differences in weight due to the feeding of antibiotics are greatest in the early periods and become smaller as the birds grow older

Some trials have shown increased efficiency of feed utilization by the use of antibiotics However, the results are not consistent in this respect

The reason for the antibiotic effect is not known, but it is believed that it functions in its influence upon the intestinal bacterial flora

The feeding of antibiotics has had a growth stimulating effect with rations containing animal protein supplements as well as with those composed entirely or largely of protein from vegetable source A number of reports have indicated relatively greater responses with the vegetable protein rations In some cases the growth on vegetable protein rations was as good as that on animal protein rations

The effect of feeding antibiotics has its greatest potential on early growth and hence in rations for meat production The information on feeding mature hens is still too limited to make definite recommendations

The various antibiotics differ somewhat in their comparative effectiveness However, relatively small amounts are sufficient Penicillin, aureomycin, terramycin and bacitracin have all been effective at the rate of five parts per million (4 5 grams per ton) and some at lower levels Higher amounts can be fed without harm, but this practice is uneconomical

At the present time antibiotics are being recommended for chick and turkey starters to be continued for at least eight weeks

KINDS OF FEED USED IN POULTRY RATIONS

Hens being fed for egg production and chicks being fed for growth need various kinds of feed, such as grains ground feeds or mash animal feed, vitamin carriers, and mineral food Fowls are primarily grain eaters In some cases the grain is ground and fed with the other ingredients as an all mash ration The more general practice, however, is to feed both ground feeds and grain To meet this need, most of the common grains are fed to a greater or lesser extent

Grains *Corn* makes a very desirable poultry feed It is extremely palatable, contains a large amount of digestible nutriment, and is attractive in color It is usually cheap, can be easily raised and transported and fits in well in crop rotation As part of the grain mixture it is generally fed cracked, although it may be fed whole, especially during the winter However, corn is a wide feed that is, it contains a large proportion of carbohydrates and must be fed in connection with other feeds Yellow corn contains a large amount of vitamin A

Wheat is also very palatable It is adaptable to feeding fowls because of its size its color and the large amount of nutriment which is present It may not give satisfactory results when fed alone as a grain, owing largely to a vitamin A deficiency

Barley is not so palatable as wheat, but it makes a very desirable poultry feed, having good composition and other desirable characteristics It contains a medium amount of fiber.

Oats, if heavy, are very desirable for poultry Light oats are of little value They have a heavy shuck and are high in fiber Oats should not exceed 30 per cent of the grain mixture

Sorghum grains, such as kafir corn and milo maize are very good feeds They have a composition much like wheat The kernels are small, with a light husk and good color They are relatively soft and fairly palatable

Buckwheat is an important feed in localities where it is grown It is used especially in the winter ration It is dark in color has a heavy husk and should be fed in amounts not to exceed 30 per cent of the scratch grain

Rye has a hard kernel and is unpalatable Large quantities may cause digestive troubles It is not very desirable but may be fed in small quantities

Sunflower seeds are frequently found in commercial grain mixtures They add variety and attractiveness to the mixture The fat content is high Because of its heavy husk and high fiber content, the amount must be greatly restricted

Ground feeds or mashes Ground feeds or mashes are desirable but not necessary All the feed eaten by the fowl must be ground in the gizzard. But the hen can take care of more feed than she can grind Thus ground feeds or mashes save the gizzard some grinding and enable the fowls to consume larger

quantities of feed It is probably due to this that usually more eggs can be obtained when part of the ration is fed ground Consequently, it is best to furnish part of the feed ground The results of a two year test at the New York State Agricultural Experiment Station show that to produce the same number of eggs 20 per cent more feed was required when all the grain was fed whole than when one half was fed whole and the other half was fed ground In some cases all the feed is given in the ground form as an all mash ration

The mash constituents should be ground evenly to prevent the birds from picking the mash over The mash should be neither too bulky nor too concentrated in order that the fowls may eat it readily It may be fed dry in hoppers or as a wet mash, or both ways, depending upon the nature of the ration and the way it is fed Ordinarily the birds will consume from one third to one half, or more, of their feed in the form of mash

Mash constituents *Corn products* Corn meal is an efficient and palatable feed It is crumbly when mixed with milk or water Generally it should form a part of all mash mixtures

Hominy is a good feed It is high in fat and total nutriment, and can be used in the same way as corn meal However, it may be lacking in vitamin A content.

Corn gluten meal and corn gluten feed are valuable feeds They are palatable and nutritious, rich in protein, and contain a large amount of vitamin A

Wheat products Wheat bran is a bulky and fibrous feed, low in nutriment, and slightly laxative It adds bulk to the ration

Wheat standard middlings is similar to wheat bran It is less bulky than wheat bran and contains more nutriment It is used in the same way

Wheat flour middlings is another by product obtained in the manufacture of flour It consists of the finer particles and contains less fiber, more protein, and more total nutrients than the standard middlings On this account it is somewhat more valuable It is more adhesive when mixed with water, and should not be used in too large quantities

Red-dog flour generally contains some of the wheat germ and is rich in protein, vitamins, and fat and is low in fiber

Wheat feed is a mixture of wheat bran and wheat middlings and is more or less variable in the proportions of these ingredients It has a composition between that of wheat bran and standard middlings It may be used in place of the bran and middlings

Ground wheat or crushed wheat can be used in the mash as a substitue for the wheat by products

Ground heavy oats Ground heavy oats are desirable constituents of the mash They are rather light and bulky Because of the high fiber content they should not exceed 25 per cent of the mash mixture They should be ground fine or pulverized

Ground barley or *ground buckwheat* These can be used as a substitute wholly or in part for ground oats

Vegetable protein concentrates The protein in the ration may come from vegetable or from animal sources The vegetable protein concentrates most commonly used in poultry rations are as follows

Soybean oil meal is probably the most useful of the vegetable protein concentrates and can be used to a considerable extent in poultry rations

Peanut meal is also a valuable vegetable protein concentrate and can be included in poultry rations in appreciable amounts

Cottonseed meal is high in protein content Results are not favorable however when large quantities are fed to hens It appears to be satisfactory for young stock

Linseed oil meal is laxative in character It is sticky in wet mash is not palatable and probably should not be fed in amounts exceeding 5 per cent

Animal protein concentrates In order to obtain the best results especially in growth and hatchability it is advisable to furnish part of the protein as animal protein The benefits are due largely to factors associated with animal protein Experiments reported from the University of Missouri Agricultural Experiment Station show that hens fed a ration containing animal protein averaged 127 eggs hens fed a ration containing a vegetable protein concentrate without mineral supplementation averaged 62 eggs and that those fed a ration containing no protein concentrate averaged 59 eggs This difference was due in large part to the mineral content

The results of a like experiment reported from the Indiana Agricultural Experiment Station are similar In these tests the birds were all fed the same grain and dry mash ration, the only difference being in the amount and the kind of meat food in the ration These latter tests show that a hen fed a ration containing meat scrap averaged 135 eggs, a hen fed a ration containing skim milk averaged 135 4 eggs, and one fed a ration containing no meat averaged 32 5 eggs

Experiments carried on at the Cornell Station show that production can be controlled to a marked degree by regulating the amount of animal protein Whenever the source of animal protein was eliminated, egg production and hatchability were decreased When animal protein was included in the ration again, reproduction was improved

Five to 10 per cent of the total ration fed should be animal protein The steady use of some form of animal protein, such as meat scrap or fish meal, cannot be emphasized too strongly It is especially necessary during the unfavorable seasons when the normal reproduction is low

Chick rations composed of soybean oil meal without animal protein will not produce as good growth as when some animal product is included As little as 2 to 3 per cent of fish meal, meat scrap, or dried skim milk in the chick ration will produce good growth The difference is probably due chiefly to the vitamins present

Meat scrap usually carries from 45 to 60 per cent protein and is one of the desirable animal feeds It is the most convenient to obtain and is usually the cheapest form of protein Meat scrap should be wholesome and fresh It is well to test it before using if wholesome, when warmed it has the odor of scorched, fresh meat

Fish products may not be so palatable as good meat scrap A good fish meal, however, can be fed in part to supply the animal protein Other fish products, such as fish solubles or condensed fish, may also be used

Tankage is less suitable for poultry than for hog feeding The birds do not like it as well as some other animal feeds It is less uniform in quality and generally does not produce as good results as does meat scrap However, high quality tankage has given satisfactory growth and production

Dried blood products are high in protein but are very unpalatable. They are not suitable for poultry feeding.

Green cut bone is exceedingly palatable and very desirable if fed fresh. It heats and spoils very readily unless unusual care is taken to keep it fresh and wholesome. Usually it is not available in quantities, which prevents it from being fed regularly. If fed at the rate of one half ounce a day to each hen, it can replace one half of the protein concentrates. Or it may be used as an appetizer to increase food consumption.

Dried and semisolid milk products are desirable feeds and may be fed with entire satisfaction if they can be obtained at a reasonable price.

Liquid skim milk and buttermilk are used to a large extent as a source of protein and riboflavin. Milk will entirely replace meat scrap if fowls are given all they will drink, but some meat scrap should be kept in the ration. Where 100 hens receive from 10 to 12 quarts of milk a day, the protein concentrates can be reduced one half.

Green feed. Green feed is an important part of the ration. It is of value in several ways. The most important fact about green feeds, however, is that they are rich in vitamins. Succulence helps to keep fowls in condition and the digestive tract in working order. It acts as a tonic to the fowl and stimulates the appetite. Such feed contains a very large amount of water (from 80 to 90 per cent) and thus adds bulk to the ration. Undoubtedly one of the factors causing increased egg production in the spring is access to green feed and sunshine. Also, fowls on range in late summer are likely to decline in egg production because of the drying up of the grass. The feeding of green feed frequently helps to control cannibalism by keeping the birds active.

Pastures. Grass range is the natural method of feeding green feed and gives the best results. Clover and alfalfa ranges are preferred.

Green alfalfa and *clover* furnish a fine feed when cut green and fed directly to the hens. These feeds are specially desirable for birds closely confined or running on bare yards.

Grass silage, made from clover, grasses, lawn clippings, or cereal grasses, either by use of molasses, phosphoric acid, or ground grain, can be used as green feed. The feeding of grass

silage, however, produces deeper colored yolks The usual recommendation is to feed 4 to 6 pounds a day to 100 hens

Alfalfa meal has given good results It should be bright green and fragrant The fiber content should not be too high Not more than 5 per cent of alfalfa meal should be included in the mash Dehydrated alfalfa meal is preferred because of its higher vitamin content

Grain pasture is valuable chiefly in the early spring Its main disadvantage is its temporary nature, inasmuch as most of the shoots soon become old and tough Rye should not be used to a large extent as it may cause diarrhea if fed in excess Where the birds are limited to small yards without any chance for alternating, it is possible to keep the birds from uprooting the plants by protecting them This may be done by placing over the area to be protected a frame from 4 to 6 inches high and covered with 1 inch mesh poultry netting This will enable the birds to pick the shoots, when they are long enough, without scratching up the plants

Sprouted grain Sprouted oats may furnish winter succulence They also provide a satisfactory way to use oats, since the absorption of water, while not increasing the nutrient, makes the grain more palatable and digestible One hundred pounds of oats will absorb enough water to make about 350 pounds of the sprouted grain The oats are fed when the sprouts are from 2 to 4 inches high The sod is removed, broken into chunks, and fed in troughs or on clean litter From 1 to 2 square inches for each hen may be fed regularly each noon

Germinated oats are sometimes used in place of the sprouted oats The grain is soaked for twenty four hours, then kept in pails or other containers or in a heap on the floor They should be stirred daily and kept moist They are fed when the sprouts are ½ to ¾ inch long or just beginning to mat This usually takes from five to seven days

Roots and *tubers* may be fed Mangels are liked by the fowls, but they furnish little if any vitamins Carrots, turnips rutabagas, and other roots may be used They usually yield less, however, do not keep so well, and are not so well liked by the fowls Carrots are probably the best of these because they contain considerable vitamin A

Potatoes do not furnish a source of green food. They should never be given raw. They may be fed when boiled and mixed with mash, but they furnish chiefly carbohydrates and thus function the same as grain and ground feed.

Cabbage, while more expensive to raise and more difficult to store than mangels, is a good succulent and contains more vitamins. The small and unmarketable heads may be used to advantage in this way.

An easy and successful way to keep cabbage during the winter where a regular root cellar is not provided is to cut it as for market and place it untrimmed, stem end on the ground, in the lee of a fence, hill, or building, or in the woods or orchard where the snow is likely to cover the ground. Place only one row deep. Cover lightly with straw and use when desired.

Vegetables, such as lettuce, onions, spinach, kale, and the like, may be used to excellent advantage as green food. Fowls relish a variety of green feeds. Their use should be made a year round practice. When the birds are on good green range, it is unnecessary to give them any other kind of green feed. When the grass dries or when the birds are confined, they should have a regular and abundant supply of some green food.

A common way of feeding cabbage or the root crops is to stick them on nails in the wall. Sometimes they are suspended on strings from the ceiling or rafters. They can also be fed in troughs, boxes, or other containers. This is especially true of cabbage. A desirable practice is to run them through a cutter or shredder and feed this shredded material in a trough or open box. This method will avoid waste and increase consumption since the hens relish it and will eat more in this readily available form. Only as much succulent feed should be given as the fowls will eat the same day or before it freezes.

Too much succulent feed should not be fed, since this might decrease grain and mash consumption.

Mineral feeds. The hen in laying condition requires a large amount of minerals. The amounts found in grains and by-products alone are not sufficient to supply the hen's needs. In fact, the new laid egg contains on a percentage basis from three to four times as much ash as the common feeds. A supply of calcium carbonate is especially needed for shell material. A lack of shell making material will result in weak shelled eggs,

which will encourage the egg eating habit, and cause a decrease in the number of eggs produced The most economical and readily available form in which to furnish lime is oystershell or high grade limestone grit The oystershell should be kept in hoppers or open boxes before the fowls at all times Each hen will consume from 2 to 4 pounds during a year

If the birds do not have access to gravel runs, they may be furnished with some kind of grit to grind their food Because the hen does not have teeth, she depends upon the grinding action in the gizzard Grit may be fed in hoppers or boxes where birds will have access to it at all times

For the best results, salt is needed by all animals It makes feeds more palatable and it aids digestion Some feeds contain a sufficient quantity, while others are deficient in this respect Some salt should be added to the mash mixture, but large amounts should be avoided The usual practice is to include ¼ to ½ per cent of salt in the ration

Complex or elaborate mineral mixtures are usually not necessary, since the mineral deficiencies of different mixtures vary and are usually restricted to a relatively few minerals The best practice is to make additions to the ration which are specific for its deficiencies

Vitamin carriers The importance of vitamins in poultry feed cannot be stressed too much The vitamin requirements of poultry can be satisfied in practice only by the use of complete rations The vitamin content of the important poultry feeds is indicated in Table 24

Vitamin A Yellow corn is an excellent source of vitamin A Where the ration contains from 40 to 50 per cent of yellow corn, chicks and laying hens do well for long periods of time However, the possibility must be kept in mind that the quantity of vitamin A supplied by this amount of yellow corn may be borderline and that the effects of partial vitamin A deficiency may eventually show up if birds are restricted to this quantity of vitamin A throughout their entire life cycle

Where the practice of adding bright green, fragrant alfalfa meal to poultry mashes is followed, however, the danger of supplying a borderline quantity of vitamin A is done away with, as alfalfa meal of this character is also a good source of vitamin A

TABLE 24 VITAMIN CONTENT OF COMMON POULTRY FEEDS

(MILLIGRAMS PER POUND)

FEEDSTUFF	CAROTENE[1]	THIAMINE	NIACIN	RIBOFLAVIN	PANTOTHENIC ACID
Alfalfa meal dehydrated (17 per cent protein)	36[2]	1.5	8.7	7.3	12.3
Alfalfa meal dehydrated (20 per cent protein)	60[2]	3.1	17.3	7.4	18.5
Alfalfa meal suncured (17 per cent protein)	24[2]			8.8	
Barley		1.7	24.1	0.8	3.7
Brewers' dried yeast		43.0	213.6	14.0	49.1
Buttermilk, dried		1.7	2.8	15.8	13.5
Corn yellow dent	1.33	1.7	9.8	0.5	2.6
Corn-gluten meal (41 per cent protein)	10		24.8	0.7	3.8
Cottonseed meal (41 per cent protein)		1.8	13.0	2.5	4.4
Distillers' dried solubles		2.7	54.3	5.2	8.9
Fish meal, Menhaden		0.2	25.9	2.4	
Fish meal, whitefish		0.4	36.0	4.0	
Meat scrap (52 per cent protein)		0.03	27.1	2.4	2.1
Meat and bone scrap (50 per cent protein)			21.4	2.1	1.5
Oats		2.9	8.2	0.4	6.8
Peanut-oil meal		3.3	77.5	2.4	24.1
Rye		2.0	7.1	0.7	4.2
Skimmed milk, dried		1.5	5.7	10.0	16.0
Milo		1.8	13.1	0.4	5.0
Soybean-oil meal (44 per cent protein)		0.8	16.7	2.0	6.1
Soybean-oil meal, solvent extracted		1.4	17.1	1.4	6.2
Wheat		2.3	28.8	0.5	6.4
Wheat bran		3.9	63.5	1.4	13.6
Wheat flour middlings		6.0	44.2	0.8	4.5
Wheat standard middlings		5.8	44.3	0.8	9.3
Whey, dried		1.8	5.1	13.0	22.4

[1] 1 milligram of β carotene equals 1666 I U (U.S P) of vitamin A.
[2] Rough approximations since carotene content is too variable for dependable averages.
(National Research Council, *Recommended Nutrient Allowances for Poultry*)

Still another practice, that of using fish oils potent in vitamin A in poultry mashes, has brought about an increase in the vitamin A content of the ration Cod liver oil is one of the richest sources of this vitamin, yet it is used essentially for vitamin D

Succulent green alfalfa, clover, and mixed grasses must not be overlooked, for these too contain large amounts of this vitamin

It appears, therefore, that cheap and excellent sources of vitamin A are available for feeding poultry and that where

sound judgment is used, the effects of vitamin A deficiency should never be experienced. Moreover, there is little possibility of feeding too much of this vitamin, as the range between the minimum quantity needed and the maximum amount it is safe to give is very wide.

Vitamin B complex. Thiamine is found in fairly large quantities in all unprocessed cereals. It is concentrated in the germ. For this reason, corn meal made from the entire corn kernel should be insisted upon. Wheat by-products, likewise, are rich in thiamine where, in the usual process of milling, they contain the wheat germ. Other excellent sources of this vitamin, such as good succulent pasturage, bright green, fragrant alfalfa meal, well-cured alfalfa and clover hay, and cabbage, are readily available to most poultrymen. The richest known natural source of thiamine is yeast, but, with few exceptions, the addition of yeast to common poultry rations has not improved them. For this reason and because of high cost, the inclusion of small quantities of yeast in poultry rations has not become general.

Riboflavin is present in large amounts in milk and its by-products. Yeast and liver are also rich sources. Green leaves and vegetables and good leguminous hay and alfalfa meal are also rich in this vitamin. Meat scraps and fish meal contain fair amounts. One of the recent developments is the production of riboflavin carriers from the by-products of the fermentation and distilling industries.

Pantothenic acid is supplied chiefly by milk products, yeast, liver, cane molasses, and green leafy materials.

Pyridoxine is supplied by whole grains, wheat by-products, yeast, cane molasses, vegetable fats, and muscle meat.

Choline is present in grains, wheat by-products, liver, meat scrap, and fish meal.

Folic acid is present in milk, liver, wheat by-products, yeast, alfalfa meal, and green leafy materials.

Biotin is found chiefly in grains, liver, yeast, cane molasses, alfalfa meal, and green leafy materials.

Vitamin B_{12} is supplied by animal protein feeds and certain fermentation products.

Vitamin D. Vitamin D is one of the most important vitamins to be considered in feeding poultry as it is not present in any of the common poultry feeds. There is no difficulty concerning

this vitamin as long as poultry receive exposure to direct sunshine The short ultraviolet rays of the sun, penetrating the surface layers of the skin, cause synthesis of sufficient vitamin D to satisfy all needs for this vitamin

But when poultry are confined for long periods of time in such a manner that the sunlight to which they are exposed passes through common window glass no benefit is received, as this grade of glass filters out the health-giving ultraviolet rays.

A common means of providing poultry kept in confinement with sufficient vitamin D is by use of fish oils. The amount to use depends upon the potency of the oil It can be fed in the dry mash the moist mash, or with the grain if it is hopper fed

Activated animal sterols are also used to furnish vitamin D Since they do not furnish vitamin A as do the fish oils consideration must be given to the vitamin A content of the ration To insure an adequate supply of this vitamin 5 per cent of good, dehydrated alfalfa meal can be included in the mash

Since the effective form of vitamin D for poultry is the 7-dehydrocholesterol, vitamin D carriers should be purchased on the basis of tests conducted with chicks Fish oils and activated animal sterols should carry a guarantee in chick units

In poultry feeding, the activated 7-dehydrocholesterol from animal sources must be used rather than the activated ergosterol from plant sources

Vitamin E Vitamin E is found in cereals, wheat by products, wheat germ and leafy green plant tissue. Fresh green alfalfa and clover are rich in this vitamin and so are the dried roughages produced from them As long as nondegerminated cereals and nondegerminated wheat by products together with leafy green food, are used in poultry feeding, there is little danger of putting together a ration deficient in vitamin E.

Vitamin K and other vitamins The chief sources of vitamin K are green leafy materials, alfalfa meal, meat, and fish products

Not much can be said concerning the possibility of new or unidentified vitamins To avoid any difficulties which the future may show because of them, the poultrymen should adhere to the use of natural feedstuffs, especially such protective feeds as green feed and animal protein feeds, and of those feed

stuffs which are the least processed in their manufacture and preparation for market

SELECTING FEEDS FOR A RATION

Composition or chemical analysis is not the only thing to be considered in selecting feeds Other factors must be thought of when one is making a choice Besides those already mentioned, the following factors should be kept in mind wholesomeness, digestibility, variety, effect on quality of product, protein–energy ratio, cost and availability, and mechanical or physical condition of the food

Wholesomeness. All feeds used should be wholesome It does not pay to use any but good grade feeds Musty or decayed feeds will cause such troubles as loss of appetite, diarrhea, limberneck, and aspergillosis

Digestibility Feeds should be selected on the basis of the nourishment they actually furnish to the hen Digestibility is associated with palatability The feeds that are most palatable to hens are usually also most digestible As a rule those feeds that are low in fiber and high in protein and nitrogen free extract are the ones that are highly digestible and most efficient These feeds are high in productive energy and are largely used in so called 'high energy' rations

Variety. Variety in the ration stimulates the appetite and increases the consumption of food Of the same or similar breeds or varieties of chickens, the large eaters are the best layers The birds that consume the most food have more material to make eggs or meat and are likely to lay more or to grow more In fact, there is a distinct relation between the amount of food consumed and the number of eggs laid, when birds of the same size and variety are compared

Furthermore, until the exact make up of feeds, in respect to all their different parts, and until the quantitative requirements of poultry are fully known, it is a safer practice not to limit the poultry ration to a very few feeds

The mash mixture should contain five or more ingredients, one being a source of animal protein The grain mixture should contain at least two grains Oats, buckwheat, and other grains high in fiber should not make up more than 30 per cent of the grain mixture

Effect on quality of product. The hen submits all feeds to a high refining process so that the characteristics of the feeds themselves do not have much effect upon the product. Some feeds, however, do have an effect upon the flavor, the odor, or the color. Green legumes, kale, sprouted oats, corn-gluten meal, and yellow corn will give a deep yellow color to the yolks of the eggs, whereas wheat and its by products, oats, buckwheat, and white corn tend to give a light color to the yolk. As far as taste is concerned, rape, fish scrap, and sometimes cabbage, if fed in too large quantities, have been reported to slightly affect the flavor of the eggs. However, cabbage that is in good condition can be fed liberally without much danger to the quality of eggs. Onions, even in small amounts, are likely to injure the flavor of flesh and eggs. Cod liver oil and fish meal may affect the flavor of the flesh, and should not be fed immediately before marketing the poultry.

Protein–energy ratio. Protein–energy ratio is the relation of the amount of protein (the tissue building material) in the feed, or group of feeds, to the combined amount of carbohydrates and fat. A balanced feed is one that has a correct protein–energy ratio, that is, enough of the various nutrients necessary for the particular purpose without having any excess to go to waste. For egg production a ratio of from 1 to 4.5 to 1 to 5.5 is desirable.

Cost and availability. Naturally the ration should be modified to fit the local market and farm conditions. Home-grown grains should be fed just so far as is economical. The particular value of each feed must be considered. For example, using the feeds which give profitable results in feeding practice is economical. The value of the feeds should also be computed on the amount of available nutrients for it is the digestible part that is of use to the bird; it is the digestible part that becomes available and is made into eggs or flesh. Thus large amounts of fibrous feeds must be avoided. It must be borne in mind, however, that the feed in question may be rendered more or less valuable than indicated by its total digestible nutrients by such other factors as the nature of the feed, the quality of the nutrients, palatability, and the kind of fiber. For example, even if oats are found to be cheapest, the amount used in the scratch grain mixture must be limited on account of the bulk.

Proper mechanical or physical condition of the feed. Proper mechanical or physical condition of the feed has a bearing upon consumption The capacity of the fowl for feed is limited and must be used to the best advantage if high production is desired The feed should be concentrated in order not to be bulky The necessary adequate food consumption will not be accomplished unless the ration is palatable Feeds with correct analysis may not be palatable Hens like such feeds as wheat, kafir corn, corn, corn meal, gluten feed, milk, and beef scrap On the other hand, blood meal, alfalfa meal, wheat bran, and oil meal are not so palatable Consequently, the poultryman should avoid, or at least greatly restrict, the amount of such feeds in the ration

Palatability depends largely upon the mechanical condition of the feed Consideration must be given such characteristics as hardness of kernel, size of particle, stickiness when mixed with water, and bulkiness Fowls do not like a very hard kernel The particles should not be too large When mixed with water, the ration should be crumbly Thus large amounts of sticky feeds should not be used The ration should be reasonably filling and yet be able to pass readily through the body A certain amount of bulk is necessary to enable the digestive juices to act readily Since hens digest little, if any, of the fiber in the ration, too much should be avoided as the fowls have to grind everything taken into the body The fiber content of the ration should not go much beyond 5 per cent Hence too much of oats, buckwheat, ground oats, wheat bran, alfalfa meal, and the like should not be fed The ration must not be too coarse nor too fine, since texture will affect food consumption

SUGGESTIONS AND QUESTIONS

1 Obtain samples of the various feed ingredients available in your locality Compare these feeds in regard to cost, analysis and physical characteristics

2 Feeds must be guaranteed and registered for sale Obtain information pertaining to laws regulating the sale of feeds in your state

3 Visit feed mills in order to become more familiar with commercial feeds

4 Become familiar with the special poultry ration ingredients

being offered for sale in your market This includes vitamin concentrates, minerals and other preparations

5 What kinds of feed do you grow? To what extent will they meet your needs?

6 Compare commercial mixed feeds obtainable in your market in regard to cost, composition, and quality

7 Compare different samples of the same feed in order to show variability of ingredients

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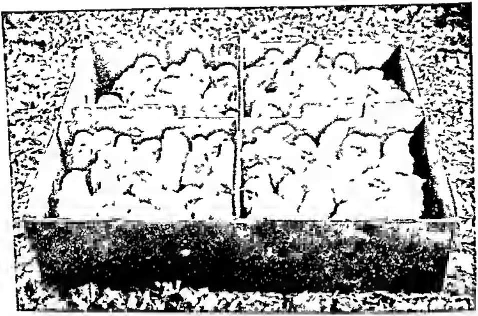
CHAPTER 7

Hatching the Chicks

OVER 90 PER CENT of the chicks reared in the United States in any one year are purchased from commercial hatcheries. If the chicks hatched for home use and not for sale are included, it is probable that about 95 per cent of the chicks are produced by artificial incubation. Artificial incubation has been known for thousands of years; the early Egyptians and Chinese were undoubtedly the first to replace the hen with man-made equipment. The knowledge of the father was passed on to the son, and what few improvements were developed were through a trial-and-error procedure. Until relatively recent times artificial incubation has been an art rather than a science. During the past fifty years, however, extensive research work has been carried on to the point where it can be said that artificial incubation is based on scientifically proved facts. A study of incubation can logically be divided into three groupings: (1) the factors inherent in the eggs previous to incubation, (2) the factors affecting the growth and development of the embryo after the egg has been placed in the incubator, and (3) the equipment and methods of management used to transform an egg into a chick, poult, or duckling.

FERTILITY

The reproductive efficiency of the domestic fowl is determined by the number of eggs, the percentage of these eggs which are fertile, and the percentage of fertile eggs that hatch. Unless an egg is fertile, it is impossible to hatch it regardless of how satisfactory the egg is otherwise and how well the environ



The objective of everyone hatching baby chicks—a high percentage of good chicks which will live and pay a profit This is the standard chick box used for shipping 100 chicks.

mental requirements are met during the incubation period. The process of egg formation has been discussed in Chapter 3; the process of production of a fertile and an infertile egg is identical, except that in the case of the fertile egg a sperm or germ cell from the male unites with the germ cell of the female. There are many factors determining fertility, mostly environmental, but there is evidence from recent work that fertility has a hereditary basis The economic importance of maintaining high fertility in a flock from which the eggs are to be used for hatching purposes is quite obvious On the average, probably between 10 and 15 per cent of all eggs produced by a breeding flock are infertile. This fact increases the cost of production of chicks appreciably, and for turkeys it is even more important because the fertility is apt to be lower than in chickens and the value of the individual poult is much greater. There are many environmental factors that affect fertility. For example, the ratio of males to females is important. If there are too few males, then all hens do not have an opportunity to mate. If there are too many males, there is interference between males

and then fertility is low The general recommendation is to allow about one male to each 12 to 15 females, but this will vary with the breed the age of the stock, particularly the male, the season of the year, and other factors Hatchery flocks usually have 7 or 8 males to 100 hens, with the thought that if one of the males should die there would still be an adequate number left A new male should not be introduced into a flock mating since there is apt to be considerable fighting and possible destruction of one or more of the males

While there is evidence to indicate that a fertile egg can be laid between 19½ to 23 hours after mating, it is impractical to depend on this when trying to obtain maximum fertility in flock mating A high percentage of fertility may generally be expected one week after the flock is mated When the males are removed, fertility will persist for a large number of birds for at least a week and possibly longer Occasionally fertile eggs will be produced a month after mating has occurred, but this is the exception rather than the rule If new males are introduced into the flock and one wants to be reasonably sure that the eggs have been fertilized by the second set of males, it is usually advisable to wait at least one week If artificial insemination is practiced this waiting period can be reduced to four days, or even three

Fertility shows some seasonal variation if the flock is kept mated continuously Accordingly where production of fertile eggs is desired during the late summer and early fall months the customary practice is to hatch cockerels early in the season, that is, in November, December, or January and mate them to hens or early hatched pullets when the males are about six to seven months of age This gives better fertility than using old males at this period Males respond to lights much as do the females, and if it is expected that the males are not to be used for producing hatching eggs until the spring months they should not be exposed to artificial illumination until about three weeks before they are to be turned into the breeding pens

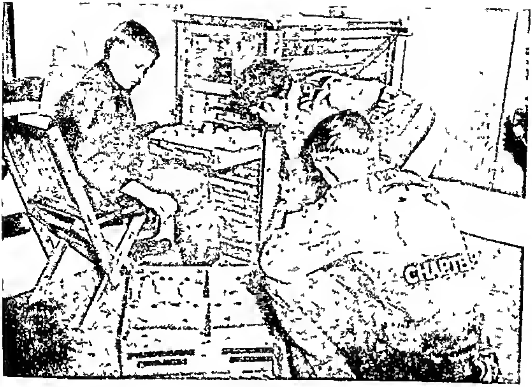
As was pointed out earlier, high fertility in the flock is very desirable from the standpoint of producing a large number of chicks per one hundred eggs set While a great deal of research has been done on the subject there are still many things that are unknown Increased attention is being given to this, and

it is expected that in the future fertility will be improved to the point where it is not a serious economic problem

PHYSICAL FACTORS AFFECTING HATCHABILITY

Nutrition One very important factor determining hatch ability is the nutrition of the breeding stock producing the hatching eggs Certain levels of nutritional deficiency will re duce hatchability to the zero point, and in other cases the de ficiency is such that the chicks can hatch but lack the ability to live Essentially feeding the breeding stock is feeding the embryo In addition there should be enough reserve food, particularly vitamins, stored in the body of the chick so that it is able to live and grow during the period immediately follow ing hatching Apparently these reserves are more important in some cases than are the nutrients in the ration fed the chicks the first few days The reserves are soon exhausted, however, and the chick starting ration must be of high quality With the increased development of hatching at all seasons of the year and the general tendency to confine breeding birds nutrition is be coming a more important problem Where the breeding flock is allowed to run out of doors it may have the opportunity of making up deficiencies in minerals vitamins, and unknown factors, but it is not advisable to depend upon this A high quality breeding ration should be fed in any case

In general, we can say that the nutrients essential for pro duction are also essential for reproduction Thus the same amount of protein is necessary in a good breeder ration as in a good laying ration the same amount of mineral nutrients, and so forth In a few cases however, the nutrients in a ration may give good production but not permit reproduction The most important of the nutrients for reproduction are riboflavin, which was formerly called vitamin G, and the so-called animal protein factors Vitamin B_{12} is usually found in animal pro tein, and there is some evidence which indicates that there are other factors in animal protein besides the B_{12} which are essen tial If one examines carefully the formula of a good laying mash and compares it to a good breeding mash, it will be found that the chief difference in the two rations is primarily in the amount of riboflavin and in the proteins from animal sources, such as fish meal, liver meal, and meat scraps All the other



An example of the use of school facilities for providing practical experience in poultry production to vocational agriculture students. These Texas Future Farmers, through operation of their chapter-owned incubator, get real training, good birds for their individual supervised farming projects, and they have a source of income for the FFA chapter treasury.

vitamins known at present to be essential for good production are also necessary for high hatchability. In addition to the vitamins, undoubtedly the amino acids play an important role, but the work in this field is not as extensive as for the vitamins. Calcium, phosphorus, and manganese are necessary in a ration for laying and breeding flocks. Fortunately they are reasonable in price and not apt to be lacking in good rations. There is considerable evidence to indicate that selenium, a mineral which is quite often found in grains grown in certain areas, is detrimental to hatchability, although apparently it has little effect on production. Under most circumstances it is not apt to be a serious problem.

There is a great deal of evidence to indicate that the viability of the chicks after hatching can be determined to a considerable extent by the quality of the rations fed to the breeding hens. Where there is any question about the minimum requirements

for hatchability, most persons who formulate feed provide an adequate amount above the minimum requirements so as to assure a good carry-over to the chicks at hatching. A complete discussion of nutrition will be found in Chapter 6.

Physiological factors. Evidence is available to indicate that physical condition of the breeding stock at the time the eggs are produced has an effect upon the hatchability of the eggs. On the average considerably lower hatchability is expected from hens than from pullets. There are exceptions, of course, but if one will carry a flock of birds through for a period of years without culling, it can be readily shown that hatchability decreases as the age of the bird increases. Likewise, studies of hatchability of individual birds show that this holds true. This is based on hatchability of fertile eggs and is not influenced by variations in fertility. Hatcherymen and poultrymen know that a flock which has had an infection of some type, such as Newcastle or bronchitis, shows decreased hatchability for a considerable time after it has returned to a high level of production. Lowered hatchability is often experienced after a period of excessively low temperatures. Many times this can be accounted for by the chilling of the eggs, but other times it cannot. Some experimental work is available with the frizzled and naked fowl where body temperatures are apt to be lower than normal under certain conditions. Hatchability in these fowls usually runs somewhat lower than that for normal birds, which indicates that a lower body temperature is a factor which would reduce hatchability. Excessively high temperatures have the same effect on hatchability, and it would seem that anything which affects normal physiology of the birds would be expressed in a lower hatching power of the egg.

Egg weight. Progressive poultrymen and hatcherymen lay considerable stress on the physical characteristics of hatching eggs. They do this for two reasons: (1) They know that egg quality, both exterior and interior, is inherited and that they can expect some improvement, particularly in exterior quality, by careful selection; and (2) they know that the physical characteristics of the egg affect hatchability. One of the things given the greatest attention is the selection for weight of eggs. Repeated experimental work and observation have demonstrated that the eggs near the average of the entire group tend

to hatch better than those excessively large or excessively small The very large eggs hatch much more poorly than do the medium or small ones It is a common practice to set only eggs weighing 24 ounces to the dozen, which is 2 ounces per egg, if the eggs come from a flock of hen breeders, and to lower the weight requirement to 23 ounces per dozen if the eggs are from pullet breeders This standard can be set wherever the hatcheryman desires, and many of them select 24 and 25 ounces as the weights for pullet and hen eggs respectively If the excessively large eggs, that is, those weighing 30 and 32 ounces to the dozen, are eliminated, total hatchability of all eggs will be increased slightly The small eggs are eliminated, although they hatch reasonably well because poultrymen do not like to reproduce birds which are in turn going to lay small eggs

One cannot be arbitrary in setting the weights of the eggs selected for hatching and have the same standard for the entire year Egg weight is also affected by the season of the year The pullets lay smaller eggs as they come into production than they will when mature Birds hatched in March, April or May will be apt to reach their maximum egg size in March of tbe following year Until that time they will gradually increase their egg size, and then when warm weather comes on, the egg size will gradually decrease until cooler fall weather when it will again show an increase Thus, if one is setting eggs from March hatched pullets during the month of October or November, he could not arbitrarily say that only eggs weighing 23 ounces to a dozen or more could be set but probably would lower the minimum weight to 22 ounces to the dozen

If the chicks to be produced from the eggs under consideration are to be used for broiler production, the standards are not as rigid as they would be if the birds were to be used for laying purposes There is a direct relationship between the size of the chick and the size of the egg from which it is hatched, but this relationship holds true only a short time, and one can obtain 3 pound broilers just as well from eggs weighing 23 ounces per dozen as from eggs that weigh 25 ounces per dozen It is well, however to separate the chicks hatched from very small eggs from the others since the chicks will be smaller and if mixed with the larger chicks, will not be able to compete with them for feed and water The same relationship holds true for

turkey eggs, but because of the increased value of the eggs they are not culled or selected very closely

The average egg size has increased during the past twenty years, until today quite often excessively large eggs are more of a problem than are small eggs The crates and cartons in common usage are not large enough for proper handling, with the result that breakage is very high Larger cases are being designed, and it is possible that this situation will be taken care of in the near future

Shell quality. Shell quality also affects hatchability The condition of the shell is affected by a number of factors, including nutrition, heredity, and environment Birds on rations deficient in calcium, phosphorus, manganese, or vitamin D will lay poor shelled eggs Ordinarily under these circumstances, however, egg production will decrease and eventually there will be no eggs of this type to set Shell quality is an inherited factor and strains of poultry vary widely in the type of shell produced With this in mind, it is well to select carefully for good quality shell, since not only will the eggs hatch better but over a period of years the selection will result in an improvement of the over all shell quality of the flock This type of selection is slow as compared to progeny test work, but it is the only practical one for large mass reproducers of chicks Age also tends to reduce the quality of the shell, and birds three four, and five years old seldom produce eggs with shell quality comparable to what they did as pullets or yearling hens This factor in itself may account in part for reduced hatchability of eggs from older hens Environmental temperatures have an influence on shell quality in that high temperatures result in the birds laying thin shelled eggs and cooler temperatures result in heavier shells This factor may also account in part for the reduced hatchability generally experienced during the summer months, particularly from old hens

The evidence concerning the influence of interior quality on hatching is not very satisfactory Early evidence indicated that poor quality white did tend to reduce hatchability, but more recent work has not supported this, and at the present time one would not have to consider seriously selection for high interior quality to improve hatchability This selection might be justified on other grounds, however Eggs with blood spots in them

will hatch almost as well as normal eggs, but there again it would be desirable to eliminate them if at all practical Eliminating blood spot eggs as based on candling only, however, will not result in improvement to any marked degree The better way would be to eliminate the hens and families that consistently produce blood spot eggs These birds must be located by breaking out eggs

Shell color Within the past few years it has been demonstrated that in brown eggs there is a tendency for the darker eggs to hatch better than the medium or lighter-colored eggs This has been shown on a large scale and can be accepted as true Unfortunately, workers have also shown that there is a tendency for the hens which lay fewer eggs to lay the dark brown eggs, so that if one selects only dark eggs to set he is selecting for high hatchability but at the same time reproducing hens which have the lower rates of production As a result of this observation, breeders with brown egg breeds who are interested in high production have not stressed selection for egg color

Age of eggs Poultrymen have known for a long time that eggs which are relatively fresh are apt to hatch better than older eggs Careful studies of this at a number of experiment stations have shown that the actual age of the egg in days may not be as important a factor as is the deterioration which has taken place In other words, an egg which has been held under unsatisfactory conditions, including high temperatures and low humidity, only a few days may be actually older in terms of hatching power than an egg which is ten days to two weeks old but which has been kept under good holding conditions Assuming however, that all the eggs were kept under a uniformly good environment it can be expected that there will be a gradual decline in hatchability occurring after the first three or four days This decline continues until none of the eggs will hatch At the end of the second week the eggs probably will hatch about 5 to 8 per cent less than they would have if they had been incubated the first week From then on the decline is much more rapid, and the hatchability of eggs held three weeks under uniform conditions probably will not be more than 35 or 10 per cent Occasionally an egg which is held for as long as a month will hatch, but this is very rare

The care of hatching eggs. As has been pointed out in the previous paragraph, the care of hatching eggs is a very important factor in maintaining hatchability over a period of time. Temperature is the most important environmental factor to be considered. Recent experimental work indicates that an egg will start development at 80° F. The optimum temperature for development is 99½° F. However, temperatures below 80° F. have a harmful effect also, and experience and research have shown that in order to maintain the optimum hatchability for eggs which are to be held for some time the eggs should be stored at temperatures between 45° F. and 65° F., with 55° F. being the most satisfactory. Many hatching egg producers and hatcherymen have found it worth while to install a special egg room, often mechanically refrigerated, for maintaining their hatching eggs at satisfactory temperatures. An increase in hatchability of only a few per cent over a period of time will pay for the investment. The evidence relative to the influence of low temperatures on hatchability is less conclusive. Apparently if the egg is not frozen, temperatures as low as freezing are not harmful, provided the egg is not maintained at that temperature for too long a period. Storage between 32° F. and 35° F. is not recommended for more than a day or two at the most. This is seldom an actual problem, since hatching eggs are usually collected two to three times a day at least and oftener in extremely cold weather, and they are then transferred to a storage room where the temperatures are considerably higher than this figure, preferably about 55° F.

These statements refer primarily to chicken eggs. On the basis of the work that is available, evidence shows that turkey eggs maintain their hatching power for a much longer period of time than do chicken eggs. It is practical to hold turkey eggs for as long a period as three weeks and still expect reasonably good results. Better results are obtained, however, if the eggs are set at least every week and, at the most, every two weeks.

There are advantages to the pedigree breeder, who is not working on a large scale, in setting eggs every two weeks. It gives him a larger number of chicks to work with at one time in making observations on feathering, weight, and similar items of economic importance. This reduces the total time necessary

It will also reduce the variability due to varying environmental conditions. In view of the fact that the decrease in hatch will be not more than 5 or 6 per cent with eggs that are held two weeks as compared to eggs that are one week old, a breeder need not be much concerned, and many feel that the advantages of less frequent hatching offset the decrease in hatchability.

The effect of humidity. The relative humidity of the air in which the eggs are being held may have some effect on the hatchability. Humidity is not as important as is temperature, but it should be given consideration. Not much work has been done in the field, but enough is available to indicate that the higher the relative humidity, the better the results. To have a relative humidity of more than 75 to 85 per cent in the egg room, however, is seldom practical, and if these figures can be reached the hatcheryman can expect quite satisfactory results. Obviously humidity as low as 25 to 40 per cent will increase the rate of evaporation of moisture from the egg and will have a detrimental effect on hatching.

The handling of hatching eggs. Hatching eggs should be carefully handled so as to prevent cracking. An unusually large proportion of cracked eggs will fail to hatch because of excessive loss of moisture. Cracked but valuable eggs from trap nest hens or turkeys can be sealed with a plastic tape or similar material. While hatchability of these eggs is not as great as from uncracked eggs, it is an improvement over the percentage that would hatch if nothing were done. Rough handling and jarring of eggs will reduce hatchability, particularly when the eggs are crated with the small end up. Under these conditions the air cell is apt to become loosened, which, for some reason, reduces hatchability. There is some evidence which indicates that jarring will reduce hatchability and increase the number of abnormalities. Accordingly, every effort should be made to pack eggs for shipment in such a manner that there is as little jarring as possible. This can be done by wrapping the eggs individually in paper before placing them in the fillers or filling the egg case with oat hulls or some other material after the eggs are packed.

The necessity of turning eggs in the incubator during the incubation process has led many people to believe that eggs be

ing held for hatching should also be turned The evidence that is available however, indicates that eggs held for as long a period as one week need not be turned, and, in a few cases the work indicated that possibly the turning was harmful If eggs are held for more than one week, the evidence indicates that they should be turned A number of tests have been run which demonstrate that eggs held for two weeks for hatching should not be turned the first week, but after the first week it is advantageous to turn them at least once a day The position of the egg during the storage period might be a factor to consider that is, eggs held on their sides on trays might need turning more than do eggs standing on the small end in ordinary cases If the hatching eggs being held are to be turned, it can be done by crating the eggs in a standard egg case and then reversing the position of the case daily by placing one end higher than the other Some operators have special cabinets built comparable to the turning rack in the cabinet incubator

Cleaning hatching eggs The best hatching egg is one which comes from the nest in a clean condition and remains that way Under ordinary conditions however 10 to 15 per cent of the eggs are soiled and the question always is whether or not these eggs should be cleaned The general practice has been to scrape these eggs with a blunt tool to remove most of the material and in a few cases the remaining dirt has been removed by sanding In recent years there has been an increased interest in washing hatching eggs and the results have been rather contradictory Many have found that washed eggs actually hatched better than the unwashed but many others have found that the percentage of spoiled eggs is increased markedly Apparently the type of bacteria present in the material on the surface of the eggs has a great deal to do with the results Eggs which are too badly soiled, particularly with yolk material, do not hatch well, and rather than set them as they are they should be dry cleaned or washed If the hatching eggs are washed very warm water, about 160° F, should be used Apparently spoilage is greatly increased when the water is as cool as the egg or cooler than it A short time exposure to these high temperatures will apparently have little effect on hatchability The eggs should not be soaked in hot water however, since this tends

to coagulate a thin layer of albumen on the inside of the shell membrane and will reduce or prevent hatching

INHERITED FACTORS AFFECTING HATCHABILITY

Most of the points that have been discussed up to this time have referred primarily to certain physical factors of the egg which can be seen and which influence hatchability Assuming however, that up to this point everything has been satisfactory, there is still one other major point that influences the results one gets in a given lot of hatching eggs This is the problem of the inheritance of hatchability Demonstrations have shown repeatedly that regardless of how satisfactory the environment is, an egg will not hatch unless it has the proper inheritance In other words, high hatchability is a genetic factor which can be selected for, and a strain or individual birds can be selected which will possess this characteristic

Generally the problem of the inheritance of hatchability is divided into two parts First, we have the general inherited ability to hatch which is determined by many genes, it is impossible for the geneticist to assign to one, or two, or three pairs of the genes the primary cause of high or low hatchability Apparently it is a complex characteristic due to many genes, as is egg production Thus, in order to improve hatchability in one's stock, it is generally necessary to carry on a detailed progeny testing program The second phase of the problem deals with the inheritance of specific characters which express themselves primarily as abnormal embryos This type probably is independent of the first type of inherited hatchability The characters have been studied in detail, and at the present time there are a number for which the mode of inheritance is known Occasionally the presence of one of these so-called lethals does cause reduced hatchability in the flock Ordinarily this is not true except in close inbreeding, however In fact, the presence of lethals in all types of livestock accounts primarily for the unfavorable reputation that inbreeding has had among livestock breeders for many generations With increased knowledge of some of these inherited characteristics, the poultry and livestock breeder has been able to develop inbred lines which will give high hatchability A fairly high per

centage of inbred lines that have to be discarded can often be traced to the presence of a lethal

The following outline lists the names of the known lethals and a brief description of each

Genetic Lethals in Chickens[1]

A Embryonic lethals (seldom hatch)

1 Stickiness egg fluids not absorbed, soft bones
2 Wyandotte lethal linked with recessive white, uncommon
3 Cornish lethal all long bones reduced in size, uncommon
4 Amaxilla abnormal upper mandible
5 Micromelia short thick appendages, parrot beak
6 Talpid duplication of digits, short legs and wings, head abnormal
7 Chondrodystrophy short legs, parrot beak
8 Deformed mandibles lower mandible nearly missing, deformed head, cerebral hernia
9 Wingless wings absent or vestigial, little down, no lungs, no kidneys
10 Crooked neck dwarf crooked neck, full body, dwarf embryo
11 Diplopodia doubling of part of legs and feet, shortened upper beak

B Embryonic lethals (some hatch)

1 Chodrodystrophy II shortened long bones, short beak
2 Creeper shortening of bones in wings and legs, homozygous chicks die, heterozygous are creepers but live, uncommon
3 Naked reduced down on embryo, some chicks live, early rearing mortality, reduced adult plumage
4 Short beak shortened upper beak, shortened leg and wing bones

C Lethals observed at hatching

1 Microphthalmia both eyes small, thickening of comb
2 Congenital loco unable to stand, head twisted with beak upward

[1] (Lerner *Journal of Heredity*, Vol 35 pp 219-24 1944)

3 Congenital perosis slipped tendon one or both legs at hatching, may be delayed for several weeks

D Late lethals

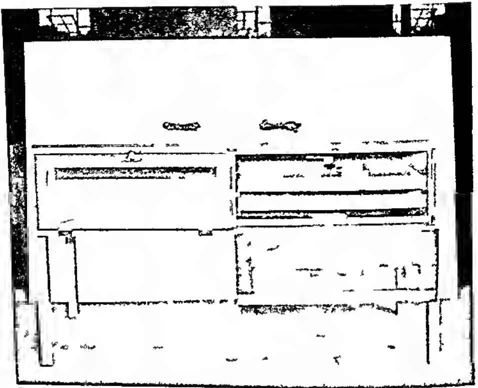
Flightless frequently embryonic lethal in homozygous condition, some homozygotes live for several months but nearly all feathers are absent Heterozygotes well feathered but flight feathers brittle and break easily

Many strains, if not most strains, of poultry carry some lethal characters at the present time, but, since practically all of them are recessive and autosomal characters in nature, they are not generally known In order to locate them, it is usually necessary to mate related birds in pedigree breeding and then break out the unhatched eggs Most poultry breeders do not consider the problem of sufficient importance to carry through with such a program

INCUBATION ENVIRONMENT AS A FACTOR IN HATCHABILITY

If it is assumed that the eggs which are to be placed in the incubator meet all the requirements of good hatching eggs, as discussed in the previous paragraphs, then the results one obtains are dependent upon furnishing an optimum environment during the actual incubation period There has been a great deal of progress in the art and science of artificial incubation during the past twenty years, but there is still room for improvement The material that follows deals with the environmental conditions which determine whether a fertile, high quality egg will or will not hatch

Temperature. Temperature is undoubtedly the most important factor in determining success in hatching Very slight variations from the optimum temperatures will have a marked effect on the hatchability even though other environmental conditions are optimum Temperature not only determines the percentage of the eggs which will hatch, but also has a marked effect on the time of hatching, the size of the chick, the percentage of crippled, poor quality chicks, and the viability of the chicks As would be expected, a study of temperature in incubation was the first item to receive any attention The



Courtesy American Incubator Company

A small electric gravity ventilated incubator of 300-egg capacity. This incubator is typical of the machine that was formerly heated by a kerosene lamp

early Chinese and Egyptians soon discovered that artificial incubation was possible if temperature was controlled

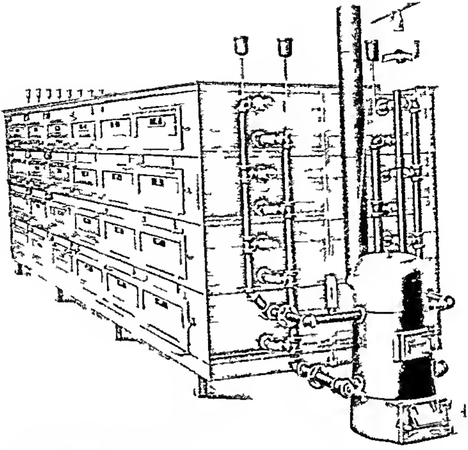
The temperature at which an incubator is to be operated is dependent upon the type of machine. In the sectional type, the natural ventilated type or the small individual incubator the optimum temperature is between 102° F and 103° F at the top of the egg. Actually comparable results have been obtained at temperatures of 101° F in the first week, 102° F the second week, and 103° F the third week. Operators find however, that a temperature of 103° F the first week, 103° F the second week, and 102° F the third week gives satisfactory results. The temperature at the bottom of the egg will vary as incubation progresses and also with the temperature of the room in which the incubator is being operated. Best results seem to be obtained where the incubator room temperature is

70° F to 75° F Under these conditions the temperature at the bottom of the egg will be about 85° F the first week, and gradually will rise until it is 90° F to 95° F the last week If the temperature of the embryo at the center of the egg could be measured, it would be approximately 99½° F This is apparently about the optimum temperature for the development of the embryo regardless of whether the egg is under a hen, in a small natural ventilated incubator, or in a forced-draft cabinet machine

In the forced-draft incubators the embryonic temperature is approximately 99½° F regardless of whether the incubator instructions call for 99° F or 100° F Different cabinet type machines are operated at slightly different temperatures even though the embryo requires the same temperature in all cases This is due to the fact that manufacturers have found through experience and experimental work that there are slight variations in temperature within the machine and changing the location of the thermometer will give slightly different readings Accordingly, they have made the adjustments in their instructions to meet these conditions It is well to follow the instructions of the manufacturer of the incubator one is using, since they are based on experience with the particular type of machine

If a separate hatcher is used, the common practice is to drop the temperature several degrees for the last three days of incubation At the same time the relative humidity is raised Experimental work has indicated that this change in environment results in a higher hatch and better-quality chicks

As has been pointed out, temperature undoubtedly is the most important single physical character affecting hatchability High temperatures, particularly early in the incubation period, will accelerate growth, and low temperatures will depress growth If the condition does not exist very long, hatchability would not be appreciably reduced Periods as long as 24 hours at high temperatures, however, will cause a very high mortality Apparently the embryos are much more susceptible to unsatisfactory environmental conditions during the first ten days to two weeks of incubation In the third week they can stand some deviation from the optimum but are more susceptible to high temperatures than to low

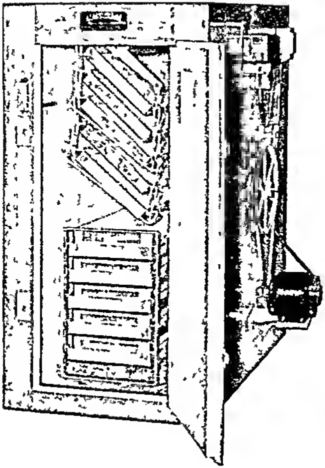


Courtesy James Manufacturing Company

Sectional gravity ventilated incubators helped to make the commercial hatchery industry pass ble Mach nes of this type were usually heated by coal a l or gas

One criterion in diagnosing a poor hatch is the time of hatch If incubators have been operated at too high a temperature they will tend to bring on chicks before the twenty first day whereas too low a temperature tends to delay hatching Other factors influence the delay however and thus it can not be re lied upon completely

Humidity Humidity is also very important in artificial in cubation In fact it is difficult to separate temperature and humidity when discussing incubation This is true because to some extent a deficiency in one can be offset by an excess of the other For example a temperature slightly below normal but with humidity slightly above normal will give results com



Courtesy American Incubator Company

A small electric forced-draft incubator and hatcher of 1,750-egg capacity.

parable to having temperature slightly above and humidity slightly below. Results will be most satisfactory however, when both are optimum. In discussing humidity in incubation one should keep clear the distinction between relative humidity and wet-bulb temperature. In practically all cabinet incubators a recommendation for control of humidity involves a wet-bulb reading. Actually this is but a guide to the relative humidity in the machine. The wet-bulb thermometer, however, is a convenient way of measuring the humidity. Most incubators operate at a relative humidity of 56 to 58 per cent with a temperature of 100° F. on the dry bulb; this will give a wet-bulb reading of 85° F. Accordingly most incubator in-

structions mention the wet bulb and dry bulb reading which are recommended for the particular machine in question

A definition of relative humidity would be as follows Relative humidity is the amount of moisture in the air compared to what that air would hold if saturated If we assume that 1 000 cubic feet of air at 100° F would hold approximately 2 8 pounds of water vapor we can say that it is 100 per cent saturated If there is only 1 4 pounds of water vapor in the air, the air would be 50 per cent saturated or it would have a relative humidity of 50 per cent (See Table 25) Relative humidity is measured by two thermometers attached to a holder which permits the thermometers to be rotated One of the thermometers has a wet wick covering the bulb This instrument is rotated so that the air will pass over it at the rate of at least 9 feet per second In a forced-draft incubator the unit remains fixed, but the air is forced over it by means of electric fans Since evaporation from the wick will be dependent upon the amount of moisture in the air, the cooling effect or depressing effect on the thermometer measures the amount of humidity In order to translate the wet bulb reading into relative humidity, it is necessary to use what is known as a psychrometer table

It has been pointed out that the optimum relative humidity varies slightly but on the average runs between 56 and 58 per cent Humidity lower than this tends to allow too great an evaporation from the egg with the result that the chick is somewhat smaller at hatching time In addition, the percentage of hatch is apt to be reduced If humidity is above normal, the rate of evaporation from the egg will be insufficient and hatchability is likewise affected (See Table 26)

If a good humidity guide is not available, and a psychrometer or wet bulb thermometer cannot be used in a naturally ventilated machine because of the slow air movement, the weight loss may be determined by weighing the whole tray of eggs or by weighing a number of individually marked eggs Generally speaking the loss in weight during incubation should be about 5 per cent per week Experienced operators are also able to determine whether the eggs are drying down properly by candling at frequent intervals The increasing size of the air cell as the incubation progresses is a good guide to experienced hatcherymen These methods are not used extensively in com

TABLE 25 Wet-Bulb Readings at Various Incubating Temperatures and Corresponding Relative Humidity in Per Cent (at the Barometric Pressure of 29 Inches)

Relative Humidity	Dry Bulb Reading				
	98.0° F	98.5° F	99.0° F	99.5° F	100° F
	Wet Bulb Reading				
	° F	° F	° F	° F	° F
Per Cent					
20	68.0	68.4	68.7	69.1	69.5
25	70.5	70.9	71.2	71.6	72.0
30	73.0	73.4	73.7	74.1	74.5
35	75.5	75.9	76.2	76.6	77.0
40	77.5	77.9	78.2	78.6	79.0
45	79.7	80.1	80.5	80.9	81.3
50	81.7	82.1	82.5	82.9	83.3
55	83.7	83.1	84.5	84.9	85.3
60	85.5	86.0	86.4	86.9	87.3
65	87.3	87.8	88.2	88.6	89.0
70	89.0	89.4	89.8	90.3	90.7
75	90.7	91.1	91.5	91.9	92.3
80	92.3	92.8	93.2	93.6	94.0
85	93.7	94.2	94.7	95.2	95.7
90	95.3	95.7	96.1	96.6	97.0

mercial incubation, however, but they are useful to the operator of a small gravity ventilated incubator

Separate hatchers are operated at slightly higher humidity than are the incubators In general, the humidity is stepped up from a wet bulb reading of 86° F to about 88° F on the nineteenth day and when the chicks begin to hatch the humidity will go into the low 90 s If the temperature is dropped at the same time, as recommended, the results are excellent A combination of high temperature and high humidity or low temperature and low humidity will give unsatisfactory results

Turning the egg. The next important factor affecting hatchability is the turning of the egg In order to obtain optimum hatchability, the eggs must be turned from the first through the sixteenth day, and preferably the eighteenth day The frequency of the turning is also important, and there will be a gradual increase in hatchability as the number of turnings is increased from two to seven or eight times every 24 hours If eggs are not turned, there is an abnormal development of the allantois which apparently interferes with normal development of the embryo In the gravity ventilated incubators, the common practice is not to turn eggs until the third day With the

TABLE 26 OPTIMUM LEVELS OF HUMIDITY

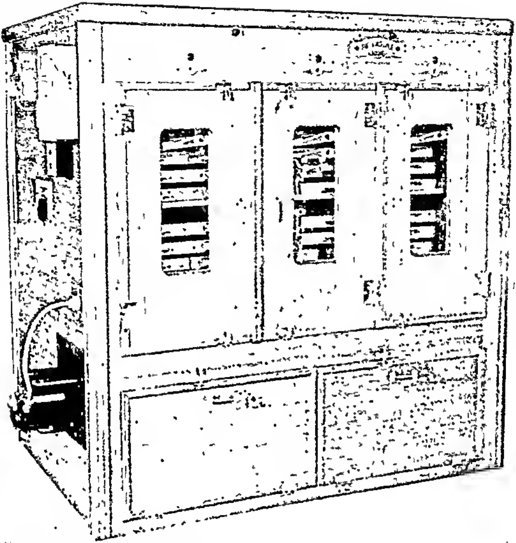
TYPE OF INCUBATOR	PERIOD (DAYS)	WET BULB (DEGREES)	DRY BULB (DEGREES)	APPROXIMATE RELATIVE HUMIDITY (PER CENT)
Chicken eggs				
Sectional	1–18	88–89	101–1st week	58–60
			102–2nd week	
	18–21	90–94	103–3rd week	60–71
Forced-draft	1–18	82 87[1]	99–100	48–61
(Combined)	18–21	90 92	99–100	70–73
Separate hatcher	18 21	90	96–98	73–78
Turkey eggs				
Sectional	1–24	88–89	100 5 1st week	61–65
			101 5–2nd week	
	24–28	92–94	102 5–3rd week	65–71
			103 0–4th week	
Forced-draft	1–24	84 88[1]	99–100	51–65
(Combined)	24–28	90–92	99–100	70–76
Separate hatcher	24–28	90	96–98	73–79

[1] Note that the average humidity for the period in the forced-draft incubator will approximate the higher figure. The higher humidity should be used until the first eggs are placed in the hatching trays.

(L W Taylor, editor, *Fertility and Hatchability of Chicken and Turkey Eggs*, John Wiley and Sons, 1949)

advent of the forced-draft machine, however, the type of construction involved necessitated turning them the first day and the results have been satisfactory There is little experimental evidence to indicate whether turning the eggs the first two or three days has any particular effect on hatchability Turning is more important up until the tenth day than it is after that time, but higher hatchability will result if the eggs are turned up until the eighteenth day, which is a common practice in all forced draft and natural-draft machines If eggs are incubated unturned during the entire 21 days, the hatchability will seldom exceed 10 to 15 per cent Possibly, turning has beneficial effects other than preventing the formation of an abnormal allantois, but this has not been studied experimentally

Position of the egg Another factor to consider in determining optimum hatchability is the position of the egg In practically all sectional incubators, eggs are allowed to assume their normal position on their side This is the position in which they would be found under setting hens Results are satisfactory, but with the advent of the forced-draft machine it was found advisable to incubate the eggs on end rather than on their sides This method of setting conserves space and facilitates



Courtesy Petersime Incubator Company

A forced-draft cabinet incubator with hatching compartment in the bottom of the machine. The air is kept in motion by means of a reel revolving around the egg drum.

holding the eggs in trays. It was found that results were just as satisfactory as when the eggs were laid on their sides, provided the eggs were set with the large end up. This is a most important fact to remember in considering the position of the egg in the incubator. Eggs incubated with the small end up will show a very low hatchability. Apparently the position of the egg determines to a considerable extent the position of the embryo within the egg. The embryo forms naturally with the head in the large end of the egg. Gravity also seems to be a fac-

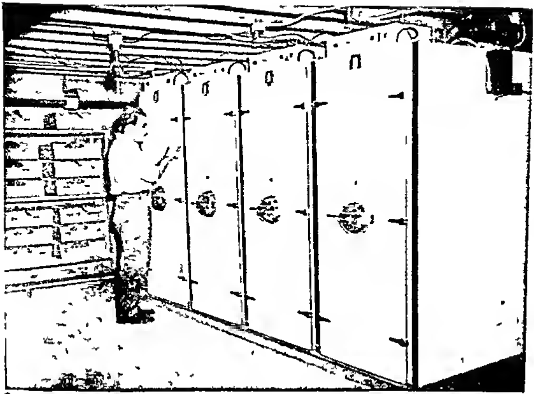
tor, however, since when eggs are incubated with the small ends up, an undue percentage of the chicks will form with the head in the small end of the egg Chicks in this position have considerable difficulty in hatching, with the result that total hatchability will be greatly reduced

Chemical composition of the air The developing egg is a living organism and, accordingly, uses oxygen and gives off carbon dioxide This means that consideration has to be given to ventilation of the incubator so that there is no deficiency of oxygen or no excess of carbon dioxide and other waste products

Experimental work indicates that for optimum development an oxygen content of about 21 per cent is desirable This is the amount in normal air, and accordingly, if the incubator and incubator room are adequately ventilated, there is no particular problem In high altitudes however, because of the reduced air pressure experimental work indicates that higher oxygen content than normal is desirable if one is to obtain satisfactory hatches Oxygen content has been controlled by introducing pure oxygen from pressure tanks, but care must be taken since an excess of oxygen can be as harmful as a deficiency

Probably inadequate ventilation will cause more difficulties from the standpoint of lack of oxygen than from an excess of carbon dioxide When there is as much as 150 parts of carbon dioxide per 10,000 parts of air however, hatchability is affected, and there is some evidence to indicate that with over 200 parts there is extremely high mortality The normal amount in the air is less than 4 parts There are no simple, reliable gauges or measuring instruments for checking the oxygen–carbon dioxide content of an incubator but the instructions which accompany the machines have been found to be satisfactory in maintaining recommended levels In general, it is suggested that when one first starts up a mammoth incubator and has only a few eggs in it the intakes be kept closed This can be done because the carbon dioxide output of the eggs is very low and the cubic feet of air space in the machine relative to the eggs is very high The second week the ventilators are opened part way and the third week they are opened almost completely The instructions vary slightly with different machines, but the recommendation is general

Ventilation at hatching time is particularly important, since



Courtesy James Manufacturing Company

A forced-draft incubator in which each unit contains eggs of one age with the unit serving as both incubator and hatcher.

ventilation serves two purposes it not only increases the oxygen supply available to the chicks which are consuming at their maximum at this time, but it also helps in preventing overheating. In fact, ventilation throughout the incubation period is used partly to control the oxygen–carbon dioxide level and partly to assist in temperature control. Practically all machines are equipped with extra air exhausts controlled by a thermostat which operate independently of the temperature thermostat controlling the primary heat supply.

Not much attention has been given to the ventilation of the incubator room, but the air should be changed at the rate of six times per hour. In introducing air into the incubator room, the inlets should be small and well distributed around the building so as to prevent cold drafts from hitting the incubators.

EMBRYOLOGY

The development of the chick embryo within the egg is a fascinating and interesting study in itself. Fortunately, it has

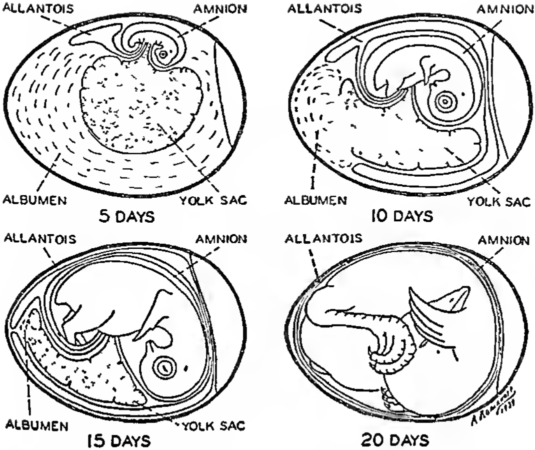
been studied extensively by many investigators and a great deal is known about the embryology of the chick With proper conditions of temperature humidity and the other factors discussed previously a fresh fertilized hen egg develops into a completely developed chick in 21 days Since the development parallels that of many other species the egg is used by many students interested in knowing more about the mysteries of life

The incubation period of the quail is 22½ days the grouse 24 days the pheasant 23½ days the chicken 21 days the turkey 28 days the duck 28 days the guinea 28 days the Muscovy duck 35 days and the goose 30 days

The female germ cell is the entire egg but the very small spot on the surface of the yolk contains the germinal material This is called the *blastodisc* If this is fertilized by germinal material from the male sperm cell it becomes the *blastoderm* The remainder of the yolk and white serve as food material from which will develop the chick If the egg is fertilized cell division begins to take place immediately and at the time of laying there are innumerable small cells already present When the egg is cooled cell division ceases until such time as the incubating temperature is again reached These cells again begin to divide and continue to divide until there is a thin disk of cells gradually formed over a small area of the yolk forming the blastoderm

As incubation progresses there is a gradual evagination resulting eventually in three layers of cells known as the *ectoderm* the *mesoderm* and the *entoderm* These three layers of cells serve as the origin or source of the various organs and systems of the body The ectoderm or outer surface becomes the skin feathers claws beak lens and retina of the eye nervous system and the linings of the mouth and vent The mesoderm or middle layer serves as the source of the reproductive and excretory organs as well as the bones muscles and blood The entoderm or inner layer produces the linings of the respiratory and secretory organs and the linings of the digestive tract If the egg is maintained at the optimum incubation temperature there is a continual growth until at 24 hours it is possible to see the head of the embryo The heart also appears just below the edge of the outside of the main portion

During the third and fourth days the *amnion* begins to de



The appearance of the developing embryo at different stages of incubation.

velop. This is one of the embryonic membranes which completely surround the embryo with the exception of the umbilical opening. The amnion is a transparent sac filled with a clear amnionic fluid, and it serves to protect the embryo from mechanical shock and in addition enables the embryo to move freely and prevents it from adhering to membranes.

There is also another embryonic membrane formed called the *allantois.* The allantois appears as an outpouching of the hind gut. It gradually forms a large sac which eventually surrounds the inside of the shell in close contact with the inner shell membrane. The allantois serves a very important function in that it becomes the embryonic respiratory organ. It takes oxygen from the outer air through the pores of the egg shell and by means of the blood system which develops takes it to the embryo. It also serves as an excretory organ in that it absorbs the carbon dioxide from the blood and releases it

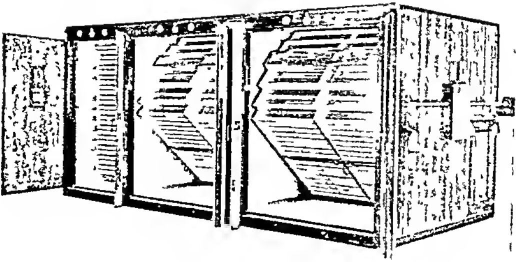
through the shell Its circulatory system also draws calcium from the shell and transports it to the developing embryo As the protein is used from the albumen by the embryo, the waste products in the form of uric acid and similar materials are deposited on the surface of the allantois If one will examine the inside of the shell after a chick is hatched, dried up membranes remaining there can be seen These are the amnion and allantois The blood vessels of the allantois are readily seen as are the waste products left as the result of the utilization of food materials in the egg by the embryo

There is a third embryonic membrane known as the *yolk sac* This also grows as a diverticulum or outpouching from the gut and gradually extends over the complete yolk It is well supplied with blood vessels, and since it is in close contact with the vitelline membrane, this system is called the *vitelline circulation* The yolk sac serves to bring nutrients from the yolk and possibly albumen from the white to the embryo Just a short time before hatching, a high percentage of the fluid is extracted by the embryo from the yolk material and the yolk is drawn into the body cavity of the chick If one will examine a 19–20 day-old embryo in the shell, it is possible to see the yolk partially drawn into the body cavity When one opens a newly hatched chick he can find a very small amount of yolk material still covered by the yolk sac and attached to the small intestine The scar on the small intestine which remains after complete absorption of the yolk may be found even after the bird is matured

The amnion, allantois, and yolk sac are all attached to the chick at the same place, and this umbilicus is known as the *yolk stalk*

The main organs of the chick are fairly well established by 72 hours, and thereafter the question is largely one of growth and somewhat less of differentiation The age of an embryo may be determined after study by looking at the relative degrees of development of certain external features Table 27 will serve as a guide for this purpose

It is impossible to describe in a relatively short space the details of embryonic development, and therefore a good book on chick embryology should be consulted if one is interested in further information on the subject.



Courtesy Robbins Incubator Company

A 32,000-egg cabinet incubator and hatcher showing the interior of the machine. The egg racks are turned forward and will assume the same position towards the rear at three-hour intervals. The air is kept in motion by means of large propellers in the rear of the machine.

If the eggs are candled daily (which is not done in commercial practice) and dead embryos removed, or if all eggs candled out are broken out to examine the age of the dead embryo, it will be found that there are two peaks of embryonic mortality. Roughly, about 16 per cent of the total dead will die at 3 to 4 days and 48 per cent at about 19 days. The exact reasons for this are not known, but apparently these are critical periods in the life of the embryo when major changes are being undergone. This is quite apparent in the 19 day embryos since the chick is preparing to hatch. The water from the yolk and amnionic fluid is being absorbed, the yolk is being drawn into the body cavity, and the lungs are preparing to function as soon as the chick breaks into the air cell.

The normal position for a chick at hatching time is with the head in the large end of the egg, beak pointed toward the air cell, and with the head under the right wing. Any deviation from this normal position tends to reduce hatchability, and some malpositions, as they are called, are almost 100 per cent

TABLE 27 IMPORTANT EVENTS IN EMBRYONIC DEVELOPMENT

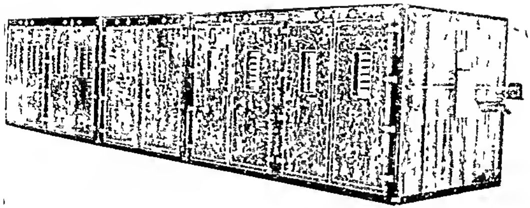
Before egg laying	Fertilization Division and growth of living cells Segregation of cells into groups of special function
Before incubation	No growth stage of inactive embryonic life
During incubation	
First day	
16 hours	First sign of resemblance to chick embryo
18 hours	Appearance of alimentary tract
20 hours	Appearance of vertebral column
21 hours	Beginning of formation of nervous system
22 hours	Beginning of formation of head
23 hours	Appearance of blood islands—vitelline circulation
24 hours	Beginning of formation of eye
Second day	
25 hours	Beginning of formation of heart
35 hours	Beginning of formation of ear
42 hours	Heart begins to beat
Third day	
50 hours	Beginning of formation of amnion
60 hours	Beginning of formation of nose
62 hours	Beginning of formation of legs
64 hours	Beginning of formation of wings
70 hours	Beginning of formation of allantois
Fourth day	Beginning of formation of tongue
Fifth day	Beginning of reproductive organs and differentiation of sex
Sixth day	Beginning of formation of beak and egg tooth
Eighth day	Beginning of formation of feathers
Tenth day	Beginning of hardening of beak
Thirteenth day	Appearance of scales and claws
Fourteenth day	Embryo turns its head toward the blunt end of egg
Sixteenth day	Scales, claws, and beak becoming firm and horny
Seventeenth day	Beak turns toward air cell
Nineteenth day	Yolk sac begins to enter body cavity
Twentieth day	Yolk sac completely drawn into body cavity Embryo occupies practically all the space within the egg except the air cell
Twenty first day	Hatching of chick

(Romanoff, Cornell Extension Bulletin 205, 1931)

effective in preventing hatching The following malpositions are the most common

1 Head between thighs
2 Head in small end of egg
3 Head towards or under left instead of right wing
4 Embryo rotated with beak away from air cell
5 Feet over head
6 Beak above right wing

Occasionally a chick may be in more than one malposition For example, it may have its head in the small end of the egg



Courtesy Robbins Incubator Company

A 62,000-egg incubator and hatcher. Each of the four units can be operated independently of the other units. The separate hatcher holds 1/7 of the total capacity, since the machine is designed for twice-a-week setting. The automatic turning device is on the right end.

and have it under the left instead of the right wing. There are other possible combinations. Various reasons are given to account for the different malpositions, but most of them are not too clearly understood. It has been pointed out that eggs incubated with the small end up tend to have a high percentage of chicks formed with their head in the small end of the egg. It is also known that with eggs of more than average size there are many more cases of malposition with the head under the left wing instead of the right wing than with the medium- or small-sized eggs.

Abnormalities. Many structural abnormalities appear during incubation and account, in a limited way, for the failure to obtain 100 per cent hatches. The cause of the abnormal development is not known, but unsatisfactory incubation conditions will increase abnormalities. Apparently very few of them are due to inheritance, but sometimes they can be traced to inadequate nutrition and other environmental factors. The most common is the abnormal development of the head. If unhatched hen eggs are opened and the embryos examined after 21 days of incubation, one will find occasional specimens with a single eye in the middle of the head, some with only one eye in the normal position, some even with no eyes, duplication of wings or legs, a few thin embryos, hernia of the skull, absence

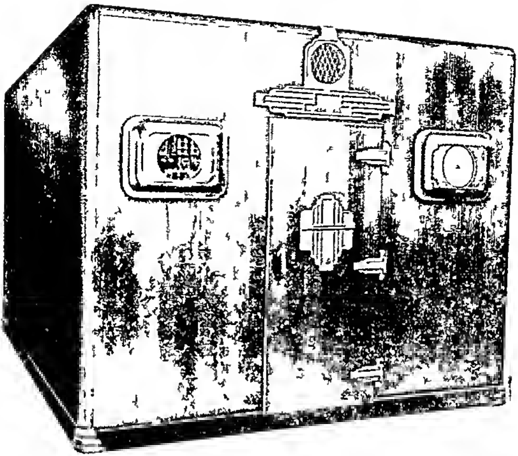
of the head, and others These are only a few, but all together they account for a small percentage of the dead in shell

INCUBATORS AND INCUBATOR OPERATION

There are two major types of incubators in use, although commercially only one is important These two are the still air or gravity ventilated and the forced-draft cabinet incubators The names are quite descriptive of the characteristics of the machines The small oil lamp or electrically heated incubator, such as was common on many farms 25 years ago, gave good results Many of them are still in use and it is still possible to purchase them With the development of commercial incubation they were discarded because of the great amount of labor required to operate them These machines consisted of small, well insulated, boxlike units holding between 50 and 600 eggs, which were laid flat in trays and which were heated by hot water pipes electric coils or hot air ducts in the top of the machine The source of heat in the hot water or hot air type was usually kerosene, although occasionally electricity was used All the eggs in each unit were set at the same time and ordinarily were turned by hand Humidity was supplied by placing water pans in the bottom of the machine, and the only control was by changing the size of the pan so as to reduce the water surface or by having sand in the pan which would increase the evaporation The amount of humidity was determined by candling the eggs at intervals to determine whether they were drying down at the proper rate

Temperature was controlled by controlling the flow of heat with a thermostat This was usually of an ether wafer type, although occasionally bimetallic units were used Ventilation was manually controlled by changing the size of the ventilator openings

The eggs were hatched in the same unit in which they were incubated It was a common practice to cool the eggs each day by placing them on the top of the machine for a short time, from the third to the eighteenth day This was done to simulate the conditions of natural incubation by the hen Later on this cooling of the eggs was found unnecessary The eggs were usually turned twice a day from the third to the eighteenth day



Courtesy Buckeye Incubator Company

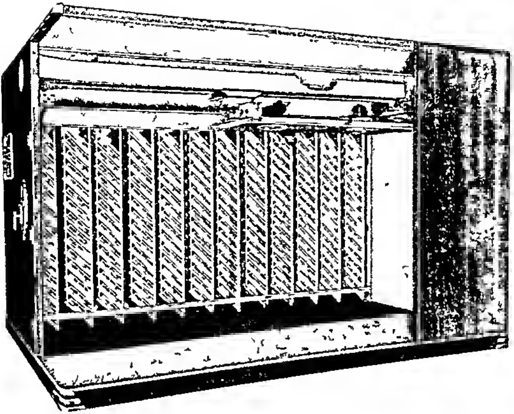
A 56,160 egg incubator The operator works inside when setting the eggs, although the traying is done outside This machine would be set twice a week A separate hatcher is used Some machines of this general design are combination incubators and hatchers and do not use the separate hatcher

The next development in artificial incubation was to attach a large number of these small units together and use a single source of heat to supply a number of sections This reduced the amount of labor a great deal, and until the development of the forced draft cabinet incubator practically all commercial hatcheries were equipped with these sectional incubators In order to save further space, they were stacked one on top of the other so that there were three or four tiers of the machine all heated by a single heat unit usually consisting of an oil, a gas, or a coal burning stove Some machines used a stove for each deck In order to simplify cleaning, the practice was to set the

eggs in the top deck the first week, move them to the second deck the second week, and for the final seven days of incubation have the eggs in the bottom deck This type of incubator gave satisfactory results and reduced the amount of labor as compared to operating a large number of small machines They were still wasteful of space and rather uneconomical to operate With this type of unit, however, it was possible to install turning devices so that a whole deck of eggs could be turned at one time The sectional type machine did have the advantage of permitting a great deal of flexibility in setting, as either the entire machine could be set at one time or only one or two sections Each compartment was controlled by an individual thermostat so that it could be operated to furnish an environment satisfactory to the eggs in it. In addition, the temperature of the heat-distribution agent could be controlled Many of these large mammoth incubators are still in operation, but the total percentage of the hatching capacity in the United States in this type of machine is very small compared to the capacity in the forced-draft cabinet machine

As has been pointed out in the discussion on temperature, machines of this type are usually operated at temperatures ranging between 102° F and 103° F Each individual operator had his own ideas as to the optimum temperature, and undoubtedly, in many cases the ideas were justified on the basis of the location of the incubator Machines of this type were rather sensitive to changes in room temperatures It took a great deal more skill on the part of the operator to obtain good hatches with this equipment than with modern-day automatically controlled equipment.

Modern forced-draft incubators trace back to 1922 when the first practical machine of this type was put on the market In 1912 considerable work had been done on a forced-draft machine, but the machine had never progressed to the point where the incubator was available for use The change from the gravity ventilated to the forced-draft machine called for a number of new ideas in incubation The use of electric fans in the machine to keep the air at a uniform temperature throughout made it possible to put many more eggs in the same unit, since they could be trayed in racks one above the other many tiers high In order to save space and to permit turning the eggs



Courtesy Buckeye Incubator Company

Cutaway of the 56,160-egg incubator shown on page 233. One row of incubating racks and trays have been removed. Notice the fan and humidifier. Others have been removed.

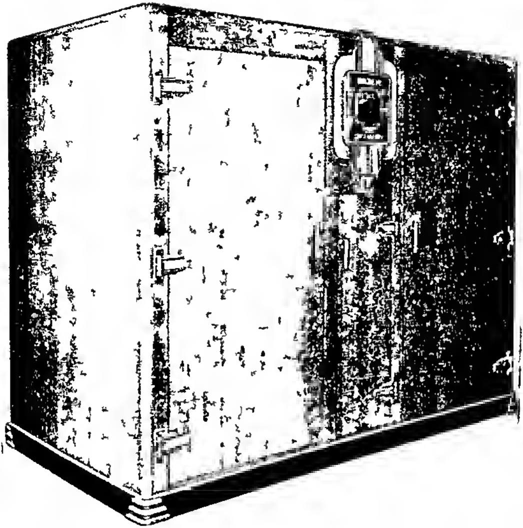
without handling them individually, it was necessary to incubate the eggs standing on the small end rather than in a horizontal position as was the previous practice The method of holding the egg trays in the machine required that eggs had to be turned starting the first day, whereas, in the old sectional machine, turning was usually started the third day. The incubation of eggs on end was in itself a new procedure. The third new step was in having eggs in the same cabinet or unit at many different stages of incubation Thus an incubator would have in it everything from fresh eggs just put in the machine to hatching chicks At least one cabinet incubator manufacturer, however, is using units in which the eggs are all of the same age of development. The development of the cabinet incubator called for additional research on temperature, humidity, and other environmental factors.

Sometime later the practice of hatching the chicks in a separate machine was developed and today most cabinet incubators have two units one for incubating the eggs up to the eighteenth day and the other for handling them from the eighteenth day until hatching The separate hatcher has the advantage of being somewhat simpler to clean and fumigate than a machine where the eggs are hatched in the same compartment as the incubating eggs In addition, it allows one environment for the incubating eggs and a different environment for the eggs that are in the process of hatching

Practically all forced-draft incubators are heated by electricity The earlier machines furnished the heat by means of hot water pipes with the water being heated by coal, oil, or gas The fans have been operated by electricity from the beginning Electricity offers many advantages over the other sources of heat and power since it is much easier to control Electricity, however, has made it necessary that reliable sources of power be available, and accordingly most hatchery operators have a separate electric generating plant to use in case of emergencies Actually quite often there is more danger of eggs overheating than underheating when the electricity fails This is particularly true in the case of the hatcher Incubating eggs give off a good deal of heat particularly in the later stages of development. With electricity unavailable to operate the fan and to maintain a uniform temperature throughout the machine, there is a tendency for the temperature to become very high in the top of the machine even though it may be too low in the bottom

In the smaller cabinet machines eggs are usually set once a week, but in the larger machines twice a week settings are practiced There are two advantages to this latter system It allows the operator to use a smaller-capacity hatcher, since one hatcher can take care of two weekly settings It also provides a better distribution of work if the eggs can be set twice a week and chicks hatched twice a week

In order to determine the weekly setting capacity of once a week hatching machines, the total egg capacity of the hatcher and incubator is divided by four Thus an 8,000 egg machine with a once a week setting calls for 2 000 eggs per setting The hatcher is also of a 2 000 egg capacity



Courtesy Buckeye Incubator Company

The separate hatcher which goes with the 56,160 egg incubator on page 233 This hatcher has a capacity of 9 360 eggs

If one wishes to increase the weekly hatching capacity, he can do so by adding a 6,000-egg incubator without obtaining an additional hatcher By setting 2 000 eggs twice a week at 3 or 3½-day intervals, he can use the same hatcher and thus will have a total setting of 4 000 eggs a week This method will give a total incubator and hatcher capacity of 14 000 eggs whereas it would take 16 000 egg capacity if but one weekly setting was made

All cabinet incubators are equipped with sensitive thermo stats which control the temperature to a fraction of a degree

Since high temperatures may be a problem at hatching time and since high seasonal temperatures interfere with incubation, the units often have cooling coils in them Ordinarily water is used for cooling and artificial cooling is not necessary Automatic turning of eggs by mechanical means, controlled by a time clock, is becoming more common In addition, most of the larger units have automatic regulation of humidity The design of the units varies considerably with different manufac turers, but they all are controlled either by a humidistat which controls the flow of water to the humidifier or by the humidifier mechanism itself

INCUBATOR SANITATION

Some chick diseases can be transmitted in the incubator at hatching time The most important of these diseases are pul lorum, omphalitus (mushy-chick disease), Newcastle, and bron chitis In order to reduce or eliminate this possibility, a program of incubator sanitation must be followed This involves cleaning and disinfecting

If the separate hatcher is used it will receive the maximum attention, since the transmission of disease is primarily at hatch ing time An occasional cleaning and fumigation of the incu bator itself is advisable, however Mechanical cleanliness is es sential At the end of the hatch, the inside of the hatcher should be thoroughly cleaned and washed A disinfectant can be used during the process but it is not essential The trays should also be cleaned, washed and disinfected with a coal tar disinfectant. The manufacturer's instructions should be fol lowed

After the machine and trays are washed and the trays are placed back in the machine, it should be fumigated with for maldehyde This product will kill the causative agents of the important chick diseases which may be present A commercial formaldehyde solution should be used Formaldehyde is a gas, but in order to handle it more easily, a solution of the gas and water is used The solution used is 40 per cent formaldehyde and 60 per cent water and is generally available This grade is often called formalin When the hatcher (or incubator) is fumigated, the temperature should be 98° F to 100° F and the humidity as high as possible—85° F to 95° F wet bulb

There are two ways of using formaldehyde for fumigation

The method used will depend upon the relative ease of use in the machine being used *The amounts of material that follow are used when the machine is empty of chicks or eggs* The potassium permanganate method was the first developed and is as follows The cubic capacity of the machine is figured and 70 cubic centimeters (2 5 fluid ounces or one half cup) of formalde hyde is used for each 100 cubic feet of space This is placed in an enamel pan or a glazed crock somewhat larger than the amount of fluid For each 100 cubic feet of space 35 grams or 1 2 ounces of permanganate are used This should be poured into the formaldehyde Place the container of formaldehyde in the machine before pouring in the potassium permanganate, since the chemical reaction of the two products immediately releases the gas, which is very irritating to the nose and eyes of humans

The second method of fumigating is more economical and should be used wherever the design of the machine permits Only 40 cubic centimeters of formaldehyde is used for each 100 cubic feet of space This is one and a half fluid ounces Cheesecloth—two square yards or more for 40 cc—is used The cheesecloth is usually fastened to a wire hanger, then the cloth is placed in a can and the formaldehyde is poured on it. The cloth is then hung in the machine The warm air of the hatcher soon evaporates the formaldehyde and fumigation re sults Care should be taken not to get the formaldehyde on the skin nor to breathe any more of it than is necessary

The preceding recommendations are for use when the hatcher is empty This strength is necessary to control ompha litis and will kill other disease organisms which may be present *Hatching chicks should not be exposed to this strength of fumi gation One half this amount is used if chicks are in the machine*

Many operators also fumigate two to three times during the time the chicks are hatching Chicks should not be exposed to more than one fumigation, however, and unless the chicks which have been fumigated and dried off can be removed, only one fumigation should be practiced during the hatch It is well to follow the incubator manufacturer s recommendations in this regard

If fumigation of the incubator is desired, the same procedure can be used, but the amount is the same as for hatching chicks, that is 20 cubic centimeters for the cheesecloth method *Eggs*

which have been in the machine for less than three days should not be exposed to formaldehyde gas

An important part of a sanitation program is to have the incubators in a room separate from chicks being brooded and, of course, from mature birds. It is a very poor practice to have battery brooders in the same room or even in rooms near the incubators.

A good sanitation program for the hatchery and incubators is a good investment. While the program may not eliminate all trouble, it can reduce it to a point where it is not a problem.

THE HATCHERY INDUSTRY

There are approximately 10,000 commercial hatcheries in the United States. During the past 20 years there has been a decrease in the number of hatcheries, but the total capacity has increased tremendously. This trend is continuing. The midwestern area has long been the most important hatchery area, but other sections have increased very rapidly and in these other areas, particularly New England, the Middle Atlantic states, the South Atlantic states and California, the hatchery business has become a year round business because of the development of the commercial broiler industry. As the broiler industry expands into the Middle West, there too, year round operation is becoming more important, although the majority of the hatcheries have a relatively short season of three to four months.

TABLE 28 Relative Importance of Eight Size Groups of Hatcheries, 1934 Compared to 1938 and 1943

Size Group (1 000 Eggs)	Number of Hatcheries		
	1934	1938	1943
1 0–9 9	4,934	2,867	2,199
10 0–24 9	3,315	3,025	2,673
25 0–39 9	1,274	1,720	1 693
40 0–59 9	895	1,262	1,353
60 0–99 9	576	896	1,176
100 0–199 9	294	541	641
200 0–499 9	102	182	289
500 0–over	15	40	88
All size groups	11,405	10,533	10,112

(U S Department of Agriculture.)

TABLE 29 Chicks Hatched by Commercial Hatcheries by Geographical Divisions (Monthly Percentage of Total Sectional Production)

Month	New England			Mid-Atlantic			West North Central		
	1938	1940	1948	1938	1940	1948	1938	1940	1948
January	10 4	7 7	7 3	6 1	3 9	6 4	1 8	1 8	1 2
February	11 9	11 4	9 7	12 6	10 9	11 2	5 2	3 3	5 1
March	16 5	16 3	14 7	24 9	23 4	19 4	18 8	18 6	19 7
April	16 7	18 4	14 1	26 1	26 2	21 2	31 7	32 2	33 3
May	10 8	10 1	10 2	16 8	18 4	13 4	29 4	28 2	25 5
June	4 8	4 2	7 5	4 5	7 0	6 8	9 6	13 2	5 7
July	4 0	6 6	6 6	1 8	1 8	4 5	8	8	1 7
August	4 3	5 0	6 0	1 1	1 9	3 2	4	4	1 7
September	4 2	4 2	5 3	1 4	1 8	3 5	6	6	1 7
October	5 6	5 6	5 5	1 5	1 2	3 5	6	4	1 5
November	5 0	5 0	7 2	1 4	1 3	3 9	5	3	1 5
December	5 8	5 5	5 9	1 8	2 2	3 0	6	2	1 4
Total	100 0	100 0	100 0	100 0	100 0	100 0	100 0	100 0	100 0

(U S Department of Agriculture)

TABLE 30 Chicks Hatched by Commercial Hatcheries for Whole United States (Monthly Percentage of Total United States Production)

Year	Jan	Feb.	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1940	3 7	6 4	19 9	28 4	21 5	9 3	2 6	1 5	1 6	1 6	1 6	1 9
1948	4 2	7 8	17 0	22 6	16 8	7 3	4 4	3 7	3 5	3 7	4 6	4 3

(U S Department of Agriculture)

TABLE 31 Chicks Hatched by Commercial Hatcheries

Region	1945	1946	1947	1948	1949	1950[1]
New England	109,446	80,767	88,047	92,707	115,315	123,698
Middle Atlantic	148,477	114,991	112,223	104,076	127,109	129,716
East North Central	401,038	299,321	294,826	269 610	311,751	293,617
West North Central	411,040	331,445	330,969	277,475	322,558	299,940
South Atlantic	262,134	213,745	226,361	272,961	326,800	369,290
South Central	157,246	132,112	133,078	131,539	168,460	188,395
Mountain	19,786	14,324	16 120	15,273	19,013	19,658
Pacific	111,606	78,833	87,969	98,249	113,934	113,907
United States	1,620,773	1,265,538	1,289,593	1,261,890	1,504,940	1,538 221

[1] Preliminary report.
(U S Department of Agriculture)

In general, hatcheries have been classified into two groups, although the distinction between them is difficult to make at times The breeder hatchery consists of a hatchery where a large part or all of the eggs incubated are produced on the farm

of the operator of the hatchery This type of operation is found in all areas but in the past has been more prevalent in the Northeast and far West and less common in the Middle West. The commercial hatchery is usually a somewhat larger unit than the breeder hatchery and, in many cases, the hatchery owns no breeding stock whatsoever It serves as a processor buying raw material—eggs—and turns it into a finished product—chicks There are many cases however, where commercial hatcherymen run a large breeding farm in connection with the hatchery, but only a small percentage of the total hatching eggs are produced on this farm Likewise, many breeder hatcherymen buy large quantities of hatching eggs from flocks of their own strain, but most of the eggs used are produced by the operator At one time the quality of chicks produced by the breeder hatchery was felt to be superior to the quality produced by the commercial hatchery Undoubtedly in the early days of the industry this was true, but at present commercial hatcheries are producing chicks of a quality comparable in every way to those produced by the breeder hatcherymen

The hatchery business is an interesting one and can be very profitable if properly managed The foundation of a successful hatchery is high quality stock, and individual hatcherymen have worked out programs for the improvement of the quality of the chicks they produce Many of them participate in the National Poultry Improvement Program, which has both disease control and breed improvement phases The individual interested in the possibilities of starting a hatchery should consult with the official state agency in charge of the plan This agency may be connected with the state department of agriculture, the state college, or may be a co-operative

In areas where chick production is apt to be highly seasonal, with maximum production being experienced only a few months in the year, many hatcherymen engage in other businesses related to the poultry industry For example, many of them operate feed and equipment stores in connection with their hatchery, or assemble and market eggs and poultry This applies more particularly to the commercial hatchery than to the breeder hatcheryman, as the latter usually has the production of eggs and breeding stock as an important phase of his activity

The individual interested in hatchery production should seek other information on the industry through studying government reports, specialized textbooks on the subject, and the trade journals of the industry Over half the hatcheries in the country are organized into an organization known as the American Poultry and Hatchery Federation, and a visit to their annual convention can be a stimulating and exciting experience Your state agricultural college or local hatcherymen can give you the address

SUGGESTIONS AND QUESTIONS

1 Identify and set a few hatching eggs each day for 19 days On the 20th day, candle and select a fertile egg of each age Carefully make a small opening in the large end of the egg by means of forceps or nail scissors, and break away the shell and the shell membrane The living embryo can then be seen If the eggs are placed in a vertical position on a small block and each egg is covered with a small beaker or water glass and placed back in the incubator, they will live for a number of days and the development can be observed

2 Remodel an old gravity ventilated incubator by replacing the top with glass and converting to electric heat The embryos prepared as indicated above can be placed in this machine and it will form a display which will attract a great deal of attention Another use for the machine would be to set a complete hatch 20 days before a fair or exhibit and give visitors the opportunity of observing chicks hatching A special display incubator can be built, in this case it should be long and narrow so as to permit more ready observation

3 Prepare a series of chick embryos for class observation Take incubated eggs of known age (you can use the extras from suggestion No 1), carefully open them and remove the embryo Discard the embryonic membranes and yolk and place the embryo in a small glass jar and cover with alcohol or a 4 per cent solution of formalin Suspend the embryo by a thread, cork the jars, and dip the cork in melted paraffin to prevent evaporation These standards will assist you when you determine the age of dead embryos which are candled out during incubation An even better method is to imbed the embryos in one of the new plastic materials which can be obtained from biological supply houses

4 Write to a number of incubator manufacturers for catalogs Compare the construction of the machines the methods of supplying heat and moisture, the efficiency of use of floor space, the cost, and other factors to be considered in purchasing an incubator

5 Take one of the incubators described in a catalog and work out a setting and hatching schedule, covering a three month period Show the number of eggs to be set, the percentage infertile, and the number of good chicks which could be expected to hatch Determine how many males and hens will be needed to produce the required number of eggs

6 Visit several nearby hatcheries and have the operator tell you about the details of producing and selling baby chicks and poults

7 Contact your state agricultural college for the address of the official state agency handling the National Poultry Improvement Program in your state Find out the method of organization, the percentage of hatcheries participating, the total egg capacity and the chick output as compared to the total state output

8 Buy or rent a small incubator and bring off a hatch Some flock owner may be willing to furnish the eggs in exchange for the chicks, or they can be purchased and the chicks sold Keep a complete record of results and expenses

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CHAPTER 8

Brooding and Rearing

ONE OF the most important tests of a good poultryman is his ability to brood and rear good pullets. Unless he can do this job well, there is very little chance of his succeeding in the poultry business. Of course, if he is a broiler producer, then his testing period is limited to the twelve weeks during which he is brooding and rearing. Since broiler production is a more highly specialized business, this discussion is pointed primarily at the person interested in rearing pullets for egg production, although the same principles apply in both cases.

The more knowledge we gain through research and observation, the more important we find the necessity of brooding and rearing under good conditions. Research work at a number of experiment stations, primarily those in Ohio, Washington, and New York, shows that the effects of good and poor brooding are observed six months to a year and a half later in the laying house. In many cases the high mortality which may be experienced in the laying flock can be traced directly to the methods under which the chicks were raised. The most important factor is contact between chicks and mature birds. For best results chicks should be reared in complete isolation, but if this is not practicable the brooder house and laying house should be as far apart as possible and different persons should care for the chicks and the mature birds. Mortality can be reduced by half in mature birds when they are brooded and reared in this manner.

WHAT IS BROODING AND REARING?

If we try to define brooding and rearing we can say that brooding is the period during which chicks need artificial heat

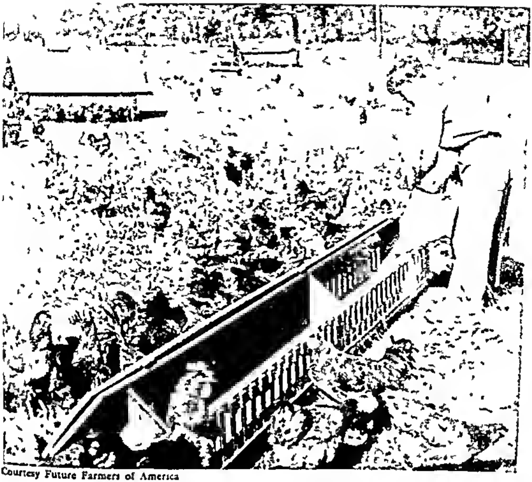
The original incubator and brooder. Few people use the hen for this purpose now

to assist in maintaining their body temperature. Rearing, on the other hand, consists of the period from the time when brooding ceases and the time when birds are ready for the laying house. In other words, the brooding period may vary from 4 weeks to 12 or 14 weeks, depending upon the time of the year.

PROVIDE A GOOD ENVIRONMENT

The chief task in brooding is providing an environment of such kind that the chicks will have the opportunity of expressing to the maximum the desirable economic characters in which the poultryman is interested. In furnishing this environment we have to consider a number of things including the temperature, humidity in the brooder house, the ventilation, the type of feed that is provided, the space allowed the birds, and the exposure to disease. These environmental factors during the brooding period can well determine the results one obtains from the flock at a later time, assuming the chicks come from good stock.

Brooding temperature. Temperature is one of the most important environmental factors during the first few weeks of the chick's life. When a chick hatches, its body temperature is about the same as the incubator from which it is hatched. It soon begins to rise, however, and within the time of ten days to two weeks reaches the normal temperature of 107° F. White Leghorns reach this temperature at a faster rate than do the heavy breeds, and it is believed that this accounts, in part at least, for the greater resistance of White Leghorns to pullorum disease. In any case, chicks are not able to maintain this body temperature without the assistance of auxiliary heat. Therefore heat should be provided from some outside source, and such arrangements will be discussed in more detail later. It has


Courtesy Future Farmers of America

This flock owned by a Massachusetts member of the Future Farmers of America has plenty of outdoor range for the summer months. Notice the large feeder that eliminates excessive fillings and provides for minimum wastage. The hinged V top keeps feed dry in rainy weather.

been found through research and experience that the optimum temperature for the usual brooders for the first week of brooding is 95° F. This temperature can be varied slightly either way without particularly affecting the chick, but it should not go below 90° F. or over 100° F. The common practice is to lower the temperature 5 degrees a week until such time as the chicks no longer require heat.

In a few special types of brooding where ceiling radiant heat, floor heat, or forced air space heaters are used, lower temperatures have been found satisfactory. Coal brooders, gas brooders, and oil brooders are usually regulated so that the temperature at the edge of the hover 2 inches above the litter is 95° F.

In electric brooders the location of the thermometer is very important, since there may be considerable variability in the temperature under an electric brooder. Accordingly, it is well to follow the manufacturer's directions for the operation of the brooder, but if the chicks tend to crowd together under the heat unit the temperature should be raised. If, on the other hand, the chicks are forced out from under the hover, the temperature should be lowered. There seems to be no uniform practice among the electric brooder manufacturers as to the location of the thermometer, therefore, each unit has to be handled separately. The height of the thermometer above the litter is also a very important factor, as these readings are dependent upon having the bulb about 2 inches above the litter. If it is much higher than this, the readings should be higher also, since the floor temperature is apt to be lower than indicated on the thermometer.

How important is humidity? Relatively little is known about the effect of humidity upon chick growth. Apparently the chicks can adapt themselves to wide ranges of humidity. For example, where a coal brooder is used, the house is apt to be dry, whereas a house with an electric brooder is likely to have a high humidity. Chicks seem to grow equally well under both conditions, but there is little research information available to verify this observation. The presence of a great deal of moisture in the litter is conducive to the development of coccidiosis; therefore, poultrymen usually prefer to have reasonably dry litter. The quality of the feathering may be affected by too low humidity, but under most conditions this is not a problem. Chick battery rooms are usually maintained at 60 to 75 per cent relative humidity.

Fresh air is necessary. In most colony brooder houses the problem of supplying fresh air is not serious. The volume of air in the house in relation to the number of chicks and the weight of the chicks is usually wide enough so that very seldom does lack of fresh air in the house cause difficulty. Occasionally if a house is too tight and an open flame heater such as a gas, oil or coal stove is used, there may be a lack of oxygen. Only in a few cases, however, have chicks been lost owing to oxygen starvation or to the presence of large amounts of carbon monoxide

or carbon dioxide. Since the brooder house is usually considerably warmer than the outdoors, there is commonly considerable leakage of air from the outside into the house. In addition, practically all poultrymen make provision for ventilating the house through special ventilators or through regulating window openings. The operator will have to use his own judgment as to the amount of ventilation, but it is desirable to introduce the air so that there are no direct drafts on the chicks. Ventilation of the poultry building has been discussed in the chapter on housing (Chapter 5).

Good nutrition. Adequate quantities of the right kind of feed are essential for the proper development of chicks. The chick does not eat very much feed, and accordingly it should have a well balanced ration containing the proper proteins, minerals, vitamins, carbohydrates, and other nutrient factors. One usually does not think of feed as being an environmental factor, but actually it is one of the most important ones, since growth can be determined to a considerable extent by the type of feed used. A complete discussion of chick rations will be found in Chapter 9.

Don't crowd the chicks. Studies have shown that the floor space available to the chicks can also have a very definite effect on growth and mortality. If chicks are overcrowded, there is more competition for a place at the feed hopper, with the result that the chick does not have an opportunity to get adequate feed. Overcrowding also tends to cause poor feathering of the birds, and mortality, particularly from diseases such as coccidiosis is more apt to be a problem. As might be expected, the space provided will depend greatly upon the age of the chicks.

The general recommendation is to allow at least one half square foot of floor space for each chick for the first six to eight weeks. This means that in a 12 by 12 foot brooder house containing 144 square feet, 285 to 300 chicks could be started. The space allowed is partly dependent upon how soon the chicks are to be turned outdoors. When the chicks are eight weeks old, they should have twice as much space. This is usually provided by removing the cockerels. If the chicks are all pullets or all cockerels, then one half of them should be moved to another

house or range shelter If the birds are allowed to run on range or out of doors, one square foot per bird is sufficient until they are ten or twelve weeks of age If the weather is mild or warm, the floor allowance can be continued until the birds are ready to go into the laying house, assuming that there is adequate roost space

If the birds have to stay in the house much of the time, however, additional space should be provided If the birds are reared in confinement, they should be given considerably more space In a few areas poultrymen like to rear their birds indoors or restrict them to the house and a porch in front of the house Likewise, the increasing practice of hatching chicks throughout the year makes additional housing space sometimes necessary If the birds are kept in confinement, they should be allowed space as follows

Age of Chick	*Floor Space for Chick*
1 to 4 weeks	½ square foot
4 to 8 weeks	1 square foot
8 to 12 weeks	1½ square feet
12 to 16 weeks	2 square feet
16 to 20 weeks	2½ square feet
over 20 weeks	3–4 square feet

Some of the problems which poultrymen brooding birds in confinement are apt to run into are cannibalism and feather pulling Where the birds are too crowded, they show a tendency to pick each other s feathers or even to eat each other Providing ample space is one of the best ways to prevent this, but if this does not serve, then it might be necessary to debeak the birds or to use pick guards Debeaking is done by cutting off a portion of the upper beak by means of a knife or a commercial electric unit.

Broiler producers can generally follow about the same requirements for space as have been outlined above There has been a tendency for these producers to crowd their birds a little more, however, and many of them allow only three-quarters square foot of space per bird until they are twelve weeks of age when the birds run out of doors If confined, allow between three-quarters and one square foot per chick until twelve weeks

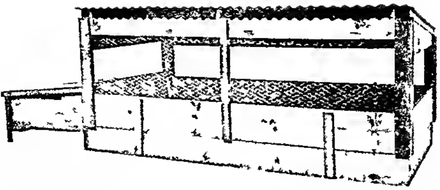
of age Studies at the Delaware and the Florida Experiment Stations indicate that the chicks reached a greater weight if allowed one square foot of space as compared to less space

The number of birds allowed to the acre for range rearing depends upon the type of soil, the rotation, and methods of management More birds per acre are permissible if the land is a well drained sand or sandy loam as compared to a heavy, poorly drained soil If different range is used each year, 400 to 500 birds per acre is a good number In any case, the feeding equipment, and possibly the watering equipment, should be moved each week or oftener This prevents bare spots on the pasture and an accumulation of droppings It gives the sun a chance to dry up the wet spots which are an ideal environment for coccidiosis and worm eggs

SYSTEMS OF BROODING AND REARING

Colony brooding The two methods of brooding and rearing chicks are the range system and the confinement system Except in specialized poultry areas, the range system is by far the most popular This method involves brooding the chicks in a brooder house and then, as they become older, allowing them to range at will over nearby areas The colony house system is particularly adapted to this method of management and is extensively used by both small and large poultrymen It has the advantage of keeping the birds in relatively small units and allowing them access to pasture where they can pick up a considerable amount of food It is also very practical because it enables the poultryman to move the houses from one part of the farm to another to avoid soil contamination and thus reduce the chances of the poultry acquiring various types of parasites

It has the disadvantage of requiring considerable land and also increasing the amount of labor needed for the rearing of the chicks Generally the colony houses are placed 75 to 100 feet apart, and thus considerable time is spent in going from one house to the other Some poultrymen meet this problem by keeping the brooder houses close together during the first six or eight weeks of brooding Then, when the chicks no longer require heat and accordingly require less attention, the houses are spread out over the range Undoubtedly range



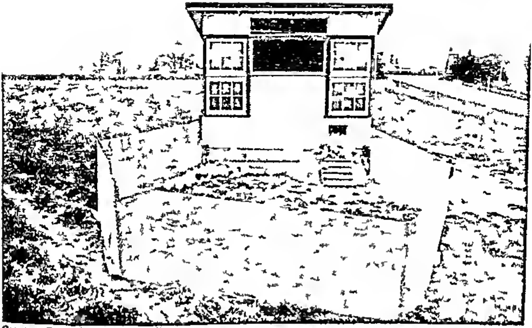
Courtesy Waugh Company

A small brooder unit commonly used in southern California These have wire floors, and the chicks are kept in them for from four to six weeks The warm area at the left is heated by electricity or gas

brooding in colony brooder houses will continue to be the most important system used on farms where fewer than 2,000 birds are reared each year

Advantages of permanent brooder houses. The confinement system of brooding and rearing is increasing in popularity, particularly in areas where commercial poultry production is important This practice is particularly useful where the birds are grown during a period of the year when they cannot be let out of doors With the increasing development of year round poultry growing, more and more poultrymen are confining their birds, particularly during the brooding period, that is, the first six to ten weeks The large permanent houses are much more economical of labor than are many small colony units scattered over a large area The use of a large permanent house makes it possible to use such labor saving devices and equipment as automatic watering systems, automatic feeding systems, a large central heating plant, and feed carriers on trolley rails Undoubtedly, where more than several thousand birds are raised each year, a large permanent house would be a very worth while investment from the standpoint of saving labor

Another advantage of a large permanent house is that the house can be used for other purposes than brooding For example, a flock of laying pullets can be kept in it during the time it is not used for brooding, and when the house is needed again for brooding, the pullets can be used to replace the losses in the



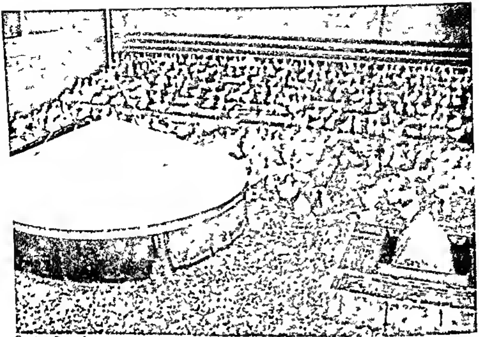
Courtesy Pennsylvania State College

Training the chicks to use the pasture The fence should be removed a few days after the chicks learn their way back to the house

laying house or can be sold It can also be used for broiler production when not needed for producing laying stock The major reason for the popularity, however, is the fact that a large permanent house does save a great deal of labor With a well planned building one individual may care for 18,000 to 20,000 chicks in a few hours per day, whereas this would be impossible under ordinary range conditions

Disadvantages of permanent houses. There are a few disadvantages to the permanent brooder house which should be considered If a disease should gain entrance it is practically impossible to prevent its spread to all the birds in the house, whereas with the range system, many times the disease can be limited to one colony house Another disadvantage is that the house is more likely to be constructed near the other large buildings on the farm, therefore the birds will probably be exposed to contact with mature birds Although the danger of fire has been reduced because of the improvements made in heating systems, a fire can cause great loss

In a few areas, particularly where broilers are grown, large



Courtesy Pennsylvania State College

Chicks should be trained to perch before the hover is removed. Putting the perches under the electric hover will be helpful.

permanent houses are used for brooding and the chicks are allowed to range in front and in the rear of the house. This system is not satisfactory for most poultrymen, however, particularly where they are raising pullets for egg production. Even where the house is located on very sandy, well-drained soil, there is likely to be considerable trouble from coccidiosis and parasites after the first year. The practice is followed in some areas where broilers are important, but even in such places, in spite of the type of soil and location, considerable trouble is experienced. It is not recommended for the average poultryman.

Combination confinement brooding and range rearing. On commercial poultry farms a combination of confinement brooding and range rearing seems to be the most satisfactory. The chicks are started in large permanent units until they no longer require heat. At that time they are transferred to range shelters or colony houses on good poultry pastures and are kept there until they are ready to be housed. This practice enables the poultryman to reduce his labor requirements a great deal during the period when the chicks require the greatest amount of

These birds are on the sun porch on which they were reared. Welded 1-by-2-inch wire makes a better floor than the poultry netting shown.

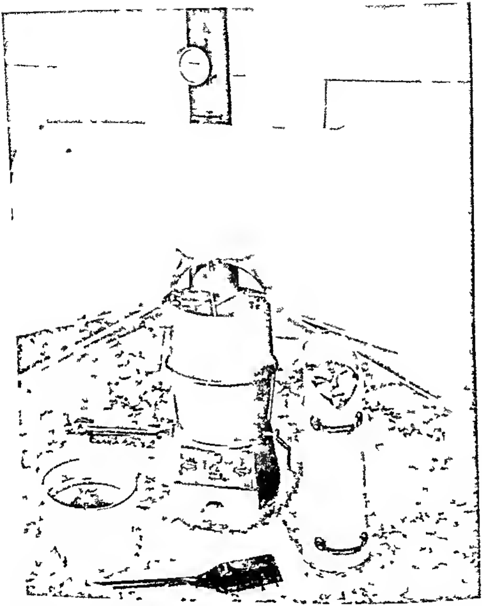
attention. At the same time it permits him to rear his birds under range conditions at a lower cost than if he had been required to furnish housing space for all the birds up until maturity. This system can be used on small enterprises also even where colony houses are used.

Heat units. There are many different types of heat units used in colony brooder houses and occasionally these units are also used in large permanent houses, but under such conditions they are not as satisfactory as a central heating system. It is impossible to say which one is best, since fuel consumption and labor vary with the different sections of the country.

Fuel Requirements per 24 Hours

Coal	*Oil*	*Electricity*	*Gas*
20-35 pounds	2-4 gallons	3-7 kilowatt-hours	100-125 cubic feet

Coal-burning brooders. The most popular heat unit is undoubtedly the coal-burning brooder stove. Where possible, anthracite or hard coal is to be preferred since it gives a more uniform fire, does not form as many ashes and clinkers, and does not deposit as heavy a residue on the pipes. In selecting a



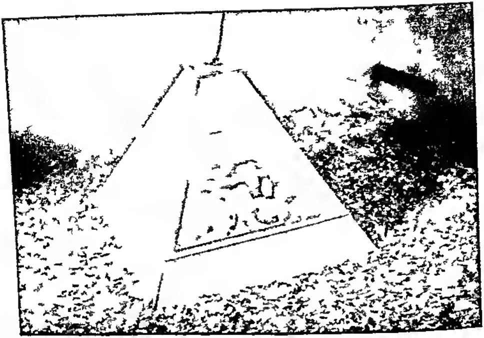
A coal burning brooder stove Notice the draft equalizer in the pipe which helps maintain an even draft The special coal scuttle simplifies the fueling

coal brooder stove one should give more attention to the coal capacity than to the size of the hover, even though most brooders are rated on hover size It is very important that the stove capacity be large enough so that two firings a day will take care of it under even the most extreme weather conditions This

means that the stove should have the capacity of at least 60 pounds of coal. The difference in cost between small and large coal stoves is very little and the extra investment is well justified. To be assured of replacement parts, one should buy a stove from a well known manufacturer. A good coal stove has a life of 15 to 20 years if the parts which quite often get broken are easily obtained.

There are a number of different types of stoves on the market, and none of them seems to show any particular superiority over the others. The most common hover sizes are 42, 52, 56, and 60 inches. While the stove with the largest coal capacity usually has the largest hover, this is not always true. In determining the capacity of a coal stove, assuming the stove is of ample size, allow 7 square inches of hover space per chick. The area of the hover can be determined by the formula πr^2 or in other words, squaring the radius and multiplying by 3.1416 ($3\frac{1}{7}$). Divide the result by 7 and the answer will be the recommended number of chicks to be placed under the stove. Actually most stoves will take care of more chicks than this, provided the room is of ample size. A common practice in many of the large broiler areas is to use two stoves in a 24-by-24-foot brooder house and put 1,000 chicks in each house. A coal brooder with a capacity of 60 to 70 pounds will take care of 500 chicks in a 16-by-16-foot brooder house. If the brooder house is only 12 by 12 feet, however, it would not be desirable to put more than 250 to 300 chicks under the same stove.

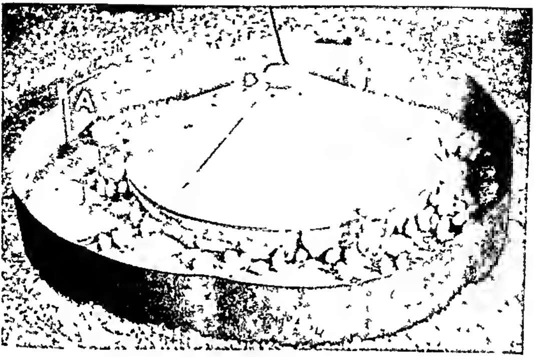
Oil burning brooders. Fuel oil and kerosene brooders are quite popular for colony brooding, since they require considerably less labor than do coal stoves. There are two chief types available. One is the so-called "blue flame" brooder, which usually consists of a wick type unit very similar to that found on kerosene oil ranges. This type of unit is satisfactory for small lots of chicks in mild weather, but is not satisfactory for cold weather or large numbers. The other type of oil brooder is commonly called the "drum" type, and it may or may not be equipped with a hover. This type works on the principle of the blowtorch except that the oil is not under pressure. The iron fire pot is so constructed that the kerosene oil or high grade fuel oil is vaporized and then burns with an intense heat. It gives off ample heat for large numbers of chicks, provided the floor



A homemade electric hover using a 250 watt heat lamp This hover is satisfactory for from 25 to 50 chicks

space is satisfactory There is somewhat more fire danger connected with the use of oil than coal but a well-constructed unit handled correctly should cause no difficulty Here again the equipment must be purchased from a reputable manufacturer whose products have been giving satisfaction Inasmuch as this type of stove needs considerable draft, it is usually necessary to have at least three or four lengths of two-foot stove pipe extending beyond the roof of the house

Electric brooders Electric brooders are becoming increasingly popular There are a number of different types on the market, as well as some very satisfactory homemade units The electric brooder and the oil brooder have the advantage over the coal brooder in the amount of labor involved in caring for the unit. Where electric current is reasonable in cost, it offers a very satisfactory system of brooding The electric brooder can be used for brooding at any time of the year, but some poultry men have difficulty in getting satisfactory results during very cold weather This is because the electric brooder does not heat the house appreciably, with the result that temperatures in the house may be very low even though under the hover the



An electric hover with paper chick guard in place. *A* is a wooden pin that holds the ends of the guard in place.

chicks are quite comfortable. It is also difficult to keep the litter dry under these conditions.

The two main types of electric brooders are the natural-ventilated and the forced-draft electric-fan types. The names are descriptive. Generally the forced-draft ventilation seems to be giving the most satisfactory results.

The forced draft electric brooder usually draws the air in at the top, passes it over a heating coil, distributes it under the hover, and forces it out at the edge. This tends to give more uniform temperature under the hover. On the other hand, the gravity ventilated unit draws the air in from the side, heats it, and then exhausts it through the center ventilator. Usually it is safer to put more chicks under a forced-draft unit than it is a gravity ventilated type, but in figuring the capacity of any electric brooder it is well to allow 10 to 12 square inches of hover space rather than the 7 square inches usually recommended for the coal brooder. In addition, since the heat is restricted to the area under the hover, it is impossible to increase these figures very much regardless of the size of the room. Satisfactory homemade electric brooders can be constructed using heat bulbs.

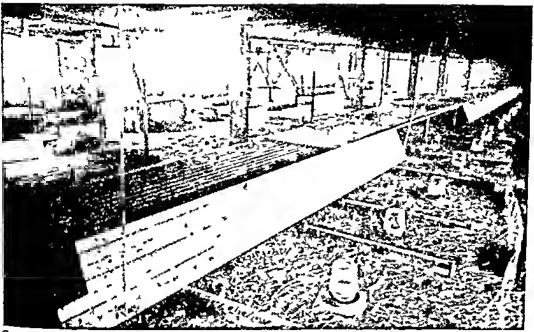
Where electric brooders are used, particularly where the room temperature is below 50°, feed and water should be kept under the hover for at least the first three or four days of brooding. If this is not done, the chicks will spend all their time under the hover and will not eat and drink as they should. Mortality is apt to be high under these circumstances. Guards of 15 inch or 18 inch metal or cardboard should be placed around the hover, close to it and touching it in a few places to keep the chicks from becoming chilled by getting too far from the heat and to train them to return to the hover for warmth.

Ventilation of the brooder room is somewhat more of a problem with the electric brooder than with the coal or oil brooder because very little heat is available for increasing the air movement.

Wood burning brooders. Wood burning brooders are used to a limited extent where supplies of home grown fuel are available. They give good results if properly handled but are not very widely used.

Gas burning brooders. Gas burning brooders are very popular and are available for use with both natural gas and bottled gas. Since bottled gas is widely available and does not necessitate keeping the brooders in one location, it is much more common than the natural gas connected to a regular service line. A well-constructed gas brooder is reasonably free from danger of fire and requires very little labor. The litter in a house where a gas brooder is used is usually somewhat drier than the litter where an electric brooder is used but not quite so dry as where a coal or oil stove is used. In many places the cost of operation may run higher than that for some of the other fuels, but because of its convenience and portability it may be preferred. In figuring the capacity of a gas brooder the customary allowance of 7 square inches per chick is followed. One should be certain that there is adequate ventilation in a gas brooder house because, in burning, the gas flame uses oxygen so that a constant supply of fresh air must be available. Ventilation should not be overdone, however, as the more cold air that is introduced from the outside, the greater the fuel consumption will be.

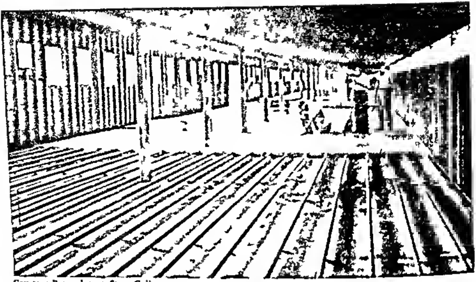
Permanent heating systems. Since large permanent houses are usually equipped with one central heating system and since



Courtesy Pennsylvania State College

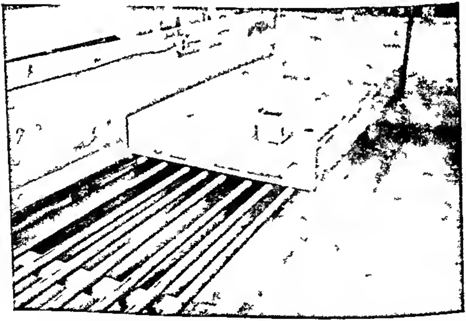
A permanent brooder house with central heating. The pipes are in the center of the house. The hover has been removed to show construction.

many types of fuel are used, to discuss them here would be impractical. Where such a central unit is planned, the poultryman should consult with a local heating specialist and follow his recommendations so far as the installation is concerned. Coal and fuel oil are the most commonly used sources of heat, although where gas is available it is very desirable. The most common method of supplying heat in a large house is by means of hot water pipes, usually eight or ten in number, with a diameter of 1½ inches, extending either along the sides of the house or down the center of the house. The hover is placed over this unit to deflect the heat to the floor. The pipes may be 10 to 14 inches above the floor and the water is circulated in them either by gravity or by circulating pumps. A pump is to be preferred because it simplifies control of the temperature under the hover. A relatively recent development in heating permanent houses is the use of floor heat. In this case ¾ inch to 1¼ inch iron or copper pipes are laid on the floor approximately 12 inches apart and are then covered with 2 to 3 inches of concrete. The entire floor becomes warm and a hover is not necessary. This system is commonly called a radiant-heating system, but actually "floor heat" is a better term. The cost of



Cou tesy Pennsylvania Sta e Colle.e

A floor heated brooder house in the process of construction

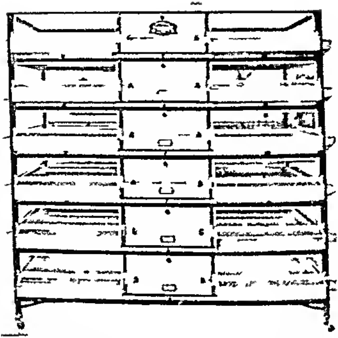


The style of hover used with some hot water permanent brooder houses. The hover will be filled with shavings which serve as insulation, and the space is available for use by the chicks

installation of a unit of this type is high, and it is used primarily where the brooder unit is used nearly the year round. Thus far its use has been limited primarily to raising broilers, ducks, and turkeys, but it can be used for the production of laying stock also. One disadvantage of the system is that the operator has to determine optimum temperatures, and this may vary for different chicks. Persons who have been using this system indicate that it provides a real saving in labor from the standpoint of cleaning, since the litter is kept dry, less litter is required, and there is also some evidence that less coccidiosis occurs because of the dry litter. Experience has indicated, however, that it does not eliminate the danger of the disease.

A number of installations have been made in which hot air is used as a source of heat for brooding chicks. There are two common methods used to provide the heat: a heat diffuser is used, such as one finds in large factories and auditoriums; or, in a few cases, a duct system very similar to that used in home heating is installed. In general, there is a great deal of interest in low-cost heating installations for large permanent units, and undoubtedly there will be a good many developments in this field in the next few years.

Use of the battery brooder. Another phase of confinement brooding which should be considered is that of battery brooding. Battery brooding has never been particularly popular in this country except in a few areas in the South, although it is a common practice in Great Britain. In this method the birds may be kept in batteries until they no longer require heat, and then they are transferred to floor pens. In a few instances poultrymen with equipment of this type have used batteries from the time the chicks were a day old until they had finished their laying period. This practice is very rare, however. The most common use of the battery on poultry farms is for starting purposes. The chicks are placed in the wire-floored battery for one to two weeks and then are placed in the floor pens. The chicks get off to a better start, with lower mortality, in batteries for the first few weeks than if the chicks were brooded under ordinary floor conditions, but most poultrymen do not consider the extra investment justified on this basis alone. In addition, difficulty may be experienced in training the chicks to use the hover as a source of heat.



Courtesy Petersime Incubator Company

Chick starting battery satisfactory for the first few weeks. Practically all batteries are electrically heated but should be placed in a room where the temperature is about 70° F

If birds are kept in batteries until they are six or eight weeks of age it is rather difficult to transfer them to floor pens since they have had no opportunity to develop immunity to coccidiosis The same is true if the chicks are reared on any other type of wire floor As a result chicks transferred from batteries or other wire floored pens to floor pens are usually handicapped for a week or two and they might actually experience considerable mortality With the development of the sulfa drugs for the control of coccidiosis part of this difficulty has been overcome Under most conditions of practical poultry management a battery system is probably not justified

While batteries are not used very extensively on most poultry farms it is well to be familiar with the equipment involved The most common battery is the starting battery where chicks can be kept for two to three weeks The limiting factor determining how long the battery can be used is the amount of head room and the size of the wire mesh floor If chicks are

kept on small mesh floors too long, the flooring will eventually clog up with droppings and many of the advantages of the battery will be lost These batteries customarily have a heating unit, usually electric, in each deck of the battery The temperature can be controlled, and a temperature of 95° F. is commonly recommended for the first week, with a 5° F drop each week thereafter This type of battery must be kept in a room where the air temperature is 70° F to 75° F, since the heating unit is inadequate to furnish heat under lower room temperatures

If chicks are kept in batteries longer than three weeks, the customary practice is to use what are called unheated batteries This type of battery has no heat unit but it should be kept in a room where the temperature is around 75° F This type of battery has larger mesh wire floors and more head room, and the space per bird is increased considerably These intermediate batteries can be used from three weeks to eight weeks or more, and then the birds are transferred to a larger battery unit The fact that the chicks require so much more space as they grow older has been one factor reducing the popularity of batteries The investment required to brood a large number of chicks in batteries is considerable The following chart indicates the amount of space that should be provided for each chick in batteries at different ages

Age of Chick	*Space per Bird*
First week	8–9 square inches
2–3 weeks	16–18 square inches
4–6 weeks	22½–25 square inches
7–9 weeks	31½–35 square inches
10–11 weeks	44–49 square inches
12– weeks	53–59 square inches

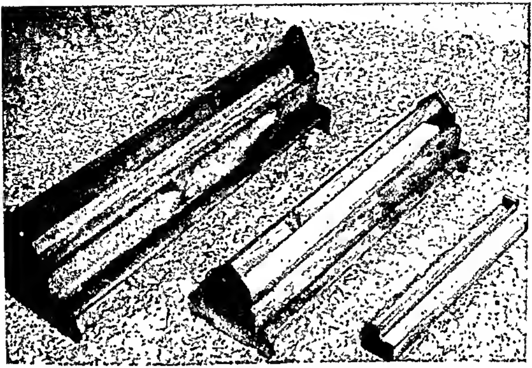
Occasionally a room type battery is used from the beginning When this is done, the individual battery units do not have the source of heat, but the brooding temperature is maintained by a high room temperature Thus for starting chicks it would be necessary to keep them in a room where the air temperature is at least 90° F and then transfer them to other rooms at a later date or lower the temperature This system was used to some extent in the development of the battery but is seldom used today

There are a few broiler plants which make use of the battery system for raising birds, but the floor systems seem to be more popular The greatest use of batteries is found in warmer sections of the country, particularly in southern California Here poultrymen find that supplementary heat beyond four or five weeks is unnecessary and the chicks can be placed in batteries out of doors with only a light shelter to protect them from the sun These birds are usually kept in laying cages as adults

EQUIPMENT

The proper selection of feeders can save both labor and feed At least three and preferably four different sizes of feeders are desirable for chicks from the time they are a day old until the time they are ready for the laying house It is poor economy to save money by using too few feeders or particularly too small a feeder Feeders should be of such design that the chicks cannot get into them, but should be large enough in capacity so that the birds will not require too frequent feeding Where grain and pellets are fed, a hopper style which will hold feed for a week or more is satisfactory, but mash is much better fed in open feeders since it tends to clog the self feeding types In New England a fairly common practice is not to use any feeders on the range after the birds are eight weeks of age Grain and pellets are fed directly on the ground and may be distributed by means of a lime spreader on the back of a truck or tractor For a small lot, they could be distributed by hand from a bucket or pail On rainy days no pellets are fed since they break up and would be wasted People who have used this system like it quite well since it encourages the use of the poultry pasture by the birds There is some question, however, that it might take more labor than the customary method of having feed hoppers which will hold enough feed for three or four days Where this system is followed it is usual to feed pellets in the morning and grain late in the afternoon

There should be ample feed hopper space for most of the chicks to feed at one time The customary recommendation is one inch of hopper space for each chick up to one month of age, two inches for one month to two months, and an extra amount from then until maturity Ample feeder space will allow most of the chicks to feed and thus prevent the larger, more aggres

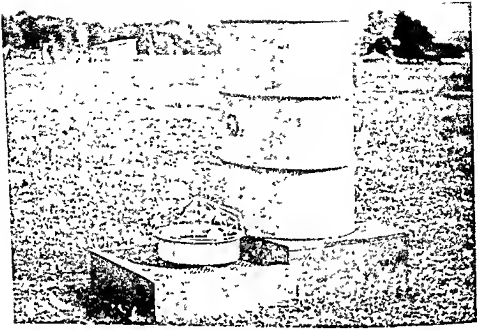


Three sizes of homemade chick feeders. These, together with a range hopper, are desirable if one wishes to reduce feed wastage.

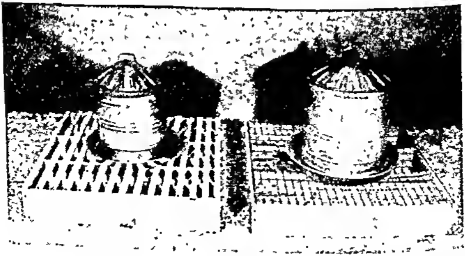
sive birds from depriving the smaller stock of their feed requirements. Considerable feed is wasted by having feeders too small and also by putting too much feed in the hoppers. It is much better to provide extra hoppers and fill them only two-thirds full.

When starting chicks, a large number of small fountains should be provided, for example, one quart unit to each 50 chicks. After the first few days these can be replaced by 2- or 3-gallon containers. The object of the small fountains is to enable the chicks to locate the water readily.

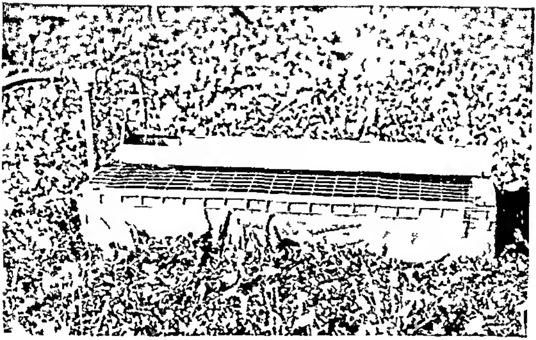
A large amount of labor can be expended in carrying water to a flock of birds, and it is highly desirable to have running water with an automatic valve in a permanent house and on the range wherever possible. If this system is not practical, then a large reservoir, such as a 55-gallon drum or barrel, should be provided since it could be filled up once or twice a week by means of a barrel or tank on a truck. An automatic valve or pan could be attached to such a barrel and thus much work would be eliminated. The watering equipment should be placed on a wire stand since there is certain to be some spillage and leakage.



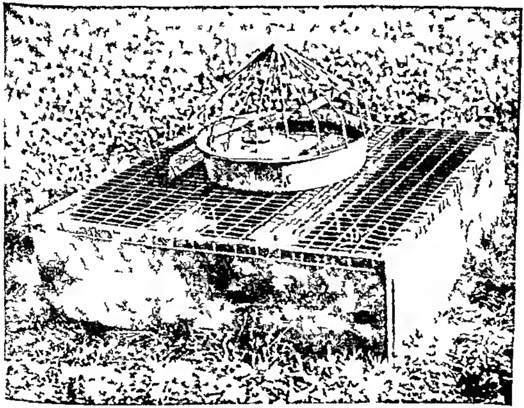
A barrel waterer for use where running water is not practical. The stand would be improved if two braces were provided under the pan in place of the one shown and if the wire covering the stand were brought down over the edge for nailing.



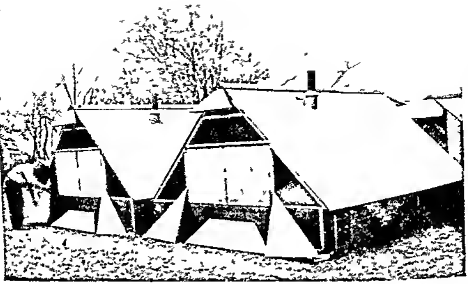
Place the water fountains on wire or wood-slat stands. This keeps the water clean and keeps the chicks from the wet, dirty areas that accumulate under fountains.



An automatic range waterer which can be moved The connection to the water line is made by means of a garden hose



An automatic water system on range saves a great amount of labor


Courtesy Pennsylvania State College

A floorless brooder house and range shelter.

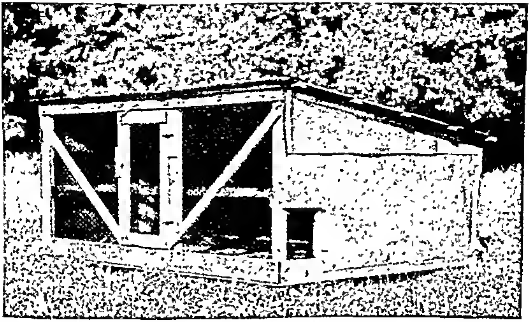
Conditions under a water pan are quite conducive to the development of coccidiosis, and a wire stand will help keep the birds from getting into the wet litter or soil.

BROODER HOUSES

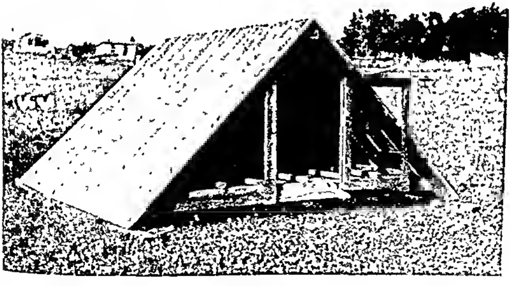
The housing equipment for brooding and rearing is an important part of the poultry enterprise. Much of what has been said about poultry housing applies to brooding and rearing equipment. The three types of buildings included in a brooding and rearing enterprise are the colony brooder house, the permanent brooder house, and the range shelter.

Colony brooder houses. There are many different designs of colony brooder houses, and no one design seems to be outstandingly superior to the others since they all have their advantages and disadvantages. Generally the colony house is 10 by 12 feet or 12 by 12 feet in size. Larger houses are satisfactory, but their increased size makes moving them difficult. One of the advantages of a colony brooder house is its portability, and the size should be kept down so that the house can be readily moved by a tractor or a truck.

Range shelters. What has been said about brooder houses also applies to range shelters; that is, they should be well enough constructed to stand frequent moving but should be



Shed-roof range shelters are preferred by some poultrymen. The roofing paper on the sides is removed during warm weather.



A practical A-style range shelter. The floor is removable.

light enough to be easily moved Considerable variability appears in the types of range shelters used on many farms as regards both size and design Some poultrymen like a light weight shelter, providing space for 50 to 60 birds, which can be moved by hand Others go so far as to build shelters which can hold 200 to 300 birds A majority of the poultrymen, however, prefer a shelter 8 by 9 feet or 9 by 10 feet, providing space for 125 to 150 birds Most range shelters are equipped with wire floors, preferably 1 by 2 inches or 1 by 4 inches welded wire, so that the birds cannot have access to the droppings If the shelters are moved to another range each year, however, wire floors are not essential although they are desirable When the shelters are left on the same land year after year, some poultrymen place a wooden platform under them so that the droppings are kept off the ground

Permanent houses Permanent brooder houses are of many sizes and styles but, in general, their construction is very similar to that of a laying house except that perches are not provided and some source of heat is added In common with other poultry buildings, permanent brooder houses are becoming deeper, and a number of them in use throughout the country are 60 feet deep There is at least one that is 100 feet deep, but this size is unusual Many of the larger producers are using two-, three-, and even four story buildings for brooding Many of our early poultry buildings were only 16 or 20 feet deep, whereas today they are 30 40, or 50 feet deep On farms where these shallow houses are available, many poultrymen have found it practical to convert them to permanent brooder houses and construct new laying houses

SOME FACTORS TO CONSIDER IN SUCCESSFUL BROODING AND REARING

Besides the points already discussed, many other factors contribute toward the success of brooding and rearing chicks

Systems of feeding There are many different systems of feeding chicks and growing stock, and while many poultrymen feel that their particular system is the best, experimental work has not been able to demonstrate any marked superiority of one system over the other The results one gets are more likely to

be the results of the quality and quantity of the feed rather than the method by which the feed is fed

The two chief methods of feeding are free choice and restricted In the case of free-choice feeding, mash and grain, or pellets and grain are kept in front of the birds at all times and they are allowed to select the feed they prefer With restricted feeding the poultryman decides how much grain and mash the birds should have and feeds them that amount Advocates of the restricted feeding system believe that they grow better birds under this system, but experimental data show that there is little difference between the two Actually restricted feeding is seldom started before the birds are six to eight weeks of age

The customary method of feeding chicks is to keep a good starting mash in front of them from the time they are a day old until they are six weeks of age At that time small amounts of grain are added to the ration, either by sprinkling it on top of the mash or by feeding it in the litter The free-choice feeder continues this system, and eventually a hopper of grain and a hopper of mash are kept in front of the birds and they select their own food The restricted feeder usually feeds mash or pellets in the morning sufficient to keep the birds feeding for an hour or so and then feeds heavily on grain at night If the birds are running on good pastures, there is an advantage in the restricted feeding in that it forces the birds to eat more of the pasture grass The system is not satisfactory, however, where the birds are brooded in confinement, since the absence of feed tends to encourage cannibalism

Broiler producers and others who raise heavy breeds have found it desirable to feed cracked grain for the first few days of the chick's life and then go to all mash feeding Observations show that, when this is done, there is less pasting up' of the chicks The reason for this is not known and there is no evidence that pasting up has any harmful effects on the growth and viability of the chicks, but it is generally considered an undesirable condition Many poultrymen start feeding fine grit very early in the chick s life and furnish it in unlimited quantities thereafter Grit seems to promote better gizzard development and possibly increases feed utilization, but it is not an essential item of management

Courtesy Future Farmers of America

These broilers will soon be ready for the pan. The North Carolina boy pictured raised the birds as a profitable, supervised farming project in vocational agriculture. The study of scientific methods of poultry management in the classroom, along with practical application on his home farm, equipped him with the knowledge necessary for poultry farming on a full scale.

With free-choice feeding, as the birds become older they tend to eat more grain and less mash, with the result that the total protein intake of the ration drops from the 20 per cent of the chick ration to 14 per cent by the time the birds are four months of age. This seems to be satisfactory, because continuing the high protein diet throughout the brooding and rearing period would not pay for extra expense of this type of ration unless the birds are to be marketed as broilers weighing from 1½ to 3½ pounds.

Good chicks are worth the difference. It is extremely important to start with the best chicks available. While there is a wide variability in the costs of chicks, one should not economize on price.

While five or ten cents per chick looks like a large difference, if one thinks in terms of the probability of a few more eggs or a little more rapid growth of the higher priced chicks, the difference in the first costs becomes relatively unimportant The desirable characteristics of rapid growth, high production, good feathering, good egg size, and good viability are all inherited, and, while they are affected by the conditions under which the chick is grown, unless these characters are inherited, even the best management cannot make good birds out of poor ones The cost of rearing good and poor stock is essentially the same

Chicks should be free of pullorum disease. It is also extremely important that chicks purchased should be free of pullorum disease This disease probably causes more loss in chicks than any other, and it is entirely avoidable if the poultryman insists on having chicks produced by hens which have been tested and found free of pullorum Nearly all states have official pullorum testing programs, and, in addition, practically all poultrymen not participating in the official program carry on their own testing program In the latter case it is necessary to communicate with the producer and find out what he is doing to control pullorum

When should chicks be started? Until relatively recently practically all chicks raised for the production of egg laying stock were hatched in the spring months However, poultrymen have found profit in rearing and housing the pullets at other seasons of the year and there is a trend toward earlier hatching This trend is caused by egg prices during the last six months of the year. At this time prices are at their highest and it is desirable to have as high a percentage of layers at this period as possible This means that chicks must be hatched in January, February, and March if they are to lay a high percentage of their eggs in the late summer and fall months

Most of the pullets will come into production between six and seven months, and one should figure back from the time when he wants high production to determine the date of hatch Brooding chicks during the cold months of January, February, and March is a little more difficult, but the production obtained from pullets hatched during this time will more than make up for the extra time and expense Many commercial poultrymen have two hatches a year, with one lot being pro-

duced in January and another in late March This plan enables them to raise twice as many birds with the same amount of brooding equipment and gives them a more uniform egg production throughout the year In any case, even the small poultryman should avoid May and June hatches, since these chicks seldom do as well as the earlier hatched chicks and, moreover, they usually do not come into production until late in the fall or early in the winter when egg prices have begun to decrease

How many chicks do you need? A number of factors will determine how large the chick order should be each year Of course the space for brooding and housing are the limiting factors The problem of the percentage of the flock which should be replaced each year is also to be considered On the average, most poultrymen plan to replace from two-thirds to three-quarters of their laying flock each year The remaining hens are culled and enough pullets are raised to bring the flock to full size The practice of replacing the entire flock each year is becoming more popular and is becoming almost a universal practice on commercial farms where the heavy breeds are kept A mature heavy fowl may be sold at almost the cost of replacing her with a pullet, and since production drops very sharply the second year, it is usually more profitable to use all heavy breed pullets In the case of the Leghorns, however the market value of the fowl is much less than the cost of raising a pullet to replace her and for that reason many poultrymen keep their best hens for a second laying year even though their egg production will be considerably lower than that of pullets

Straight run or sexed chicks If one purchases unsexed chicks they will usually average about 50 per cent cockerels and 50 per cent pullets Occasionally this will vary somewhat one way or the other Cost account figures on New York farms show that straight run chicks may be raised more cheaply than sexed pullets, in spite of this fact, the majority of poultrymen are now buying sexed pullets Table 32 shows a comparison of costs for 1940 to 1941 A 1947 study shows the same differences although the total cost per pullet is twice as great

Sexed pullets usually cost twice as much as the straight run chicks plus the cost for sexing This fact is true of the Leghorns because the surplus cockerels are usually disposed of without

A poultry pasture scene. Range shelters, feeders, shades, and waterers are spread so as to encourage the birds to range.

TABLE 32 COST OF RAISING PULLETS, 80 POULTRY FARMS, NEW YORK, 1940–41

ITEM	SEXED PULLET CHICKS		STRAIGHT RUN CHICKS	
	Light Breeds	Heavy Breeds	Light Breeds	Heavy Breeds
Number of farms	25	11	30	14
Chicks started per farm	1,214	1,291	2,881	2 180
Pullets raised per farm [1]	1 000	952	1,071	721
	DOLLARS			
Costs				
Feed	0 51	0 69	0 67	0 90
Labor	0 22	0 26	0 27	0 37
Chicks	0 28	0 24	0 33	0 32
Use of buildings and equipment	0 06	0 08	0 09	0 10
All other costs	0 12	0 10	0 13	0 20
Total	1 19	1 37	1 49	1 89
Returns, other than pullets raised				
Cockerels	0 03	0 03	0 45	0 90
All other returns	0 01	0 02	0 02	0 03
Total	0 04	0 05	0 47	0 93
Net cost per pullet	1 15	1 32	1 02	0 96

[1] Since (1) the average date on which the chicks were started was practically the same for both breeds, and (2) a longer period of time was required for the heavy breed pullets to reach maturity the process of equating the pullets to maturity reduced the number of pullets raised per farm more on the farms with heavy breeds than on those with light breeds.

cash return In the case of the heavy breeds the pullets can usually be purchased for about one and a half times the cost of straight run chicks since the cockerels can be marketed as broiler chicks In spite of the fact that the sexed pullets cost slightly more to raise than do the straight run chicks, their popularity is increasing, since the poultrymen find that they can raise better-quality pullets with possibly a little less invesment in equipment than by buying straight run chicks One can brood 250 sexed pullets in one 10 by 12 foot colony house up until eight weeks of age and then transfer the extra pullets to a range shelter If straight run chicks were purchased, two

to figure on buying $2\frac{1}{2}$ straight run chicks for each pullet one expects to house in the fall This takes care of the fact that half the lot will be cockerels and that there will be some mortality and culling If sexed pullets are purchased, buy about $1\frac{1}{4}$ chicks for each pullet one expects to house Thus, if a poultry man plans to house 100 pullets, he should purchase about 250 straight run chicks or 125 sexed pullets

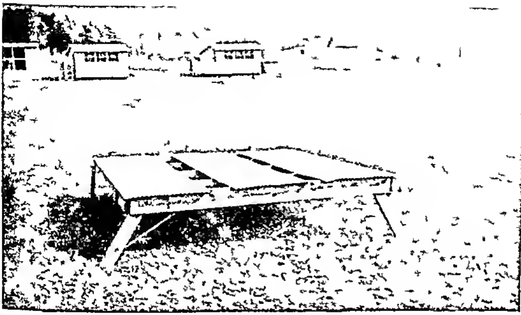
Poultry pastures. Poultry are raised on all types of soil, but if there is any choice, one would select a sandy or gravelly loam This type of soil will grow a good pasture and at the same time will be well drained Good pasture kept mowed will reduce the cost of growing pullets from 5 to 15 per cent, depending on how the pasture is managed and how the birds are fed The pasture should be mowed frequently so as to promote the growth of the young, tender, green grass or clover In order to obtain maximum consumption of the pasture grass, feed must be restricted, and many poultrymen do not feel that the prac tice is worth while If it is followed, however, the restriction should not exceed 15 per cent of the normal feed consumption The easiest way to control the amount of feed is to hand feed mash in the morning and the grain at night Another saving through the use of good pasture is that the growing ration does not have to be of as good quality as when the birds are confined or grown on poor pasture Where the poultry brooder house or range shelter is moved from one part of the farm to the other each year, 600 to 800 birds per acre may be raised If the house or shelter is to be kept in the same pasture in successive years, the number of birds should be limited to 400 or 500 per acre

Many poultrymen raise their birds on alfalfa pasture, and this is quite satisfactory although a mixture of 1 or 2 pounds of Ladino clover and 10 pounds of bluegrass sowed at the rate of 12 pounds to the acre will give better results since these are more palatable

Poultry pastures should be on well-drained soil as described previously In addition, heavy, dense shade is undesirable since there is more apt to be trouble with parasites and coccidiosis under these conditions In the past an orchard was considered a good place to grow pullets, but it has been found more de sirable to have the birds on open pasture and then to provide artificial shade or plant sunflowers or corn in rows

Pastures mowed frequently will give returns Some poultrymen use the cuttings for hay, others mow more frequently and leave the clippings on the ground

Heredity, environment, or both The results one gets with chicks depend on two major things environment and heredity If you are producing broilers, then growth and feathering, together with low mortality, are the important factors Under environment there are many items to consider Nutrition and disease have already been mentioned In addition, the temperature and the time of the year are important factors in growth rate Generally speaking, chicks grow better at cooler temperatures than they do at warmer temperatures For this reason, the poultryman knows that his chicks hatched in March and April will grow much more rapidly than those hatched in May and June The high temperatures experienced during the summer tend to depress growth, and for broilers this might be important since the birds are usually marketed at twelve to thirteen weeks of age Quite often pullets will ultimately reach the same body weight, but the growth is delayed until cooler temperatures are experienced Inadequate nutrition or the presence of disease or parasites also depress growth and will result in an inefficient, unevenly developed flock



Range shade is used where natural shade is not available The legs fold for winter storage

The important part heredity or inheritance plays in results is quite often overlooked Most of the things in which we are interested in a flock of poultry are determined by the inherit ance of the birds Of course we seldom expect White Leghorns to weigh as much as Rhode Island Reds or Barred Rocks, but there is also considerable variability within the breed For example, some strains of Barred Rocks grow rapidly, others grow slowly Likewise, mature body weight of these strains differs considerably

BROODING AND REARING MANAGEMENT

Getting ready for the chicks One should start to get ready for the chicks well in advance of the time when they are expected The first job is to clean the brooder house thoroughly if it has not already been done This job is more important than disinfecting the house, but the two processes together are even better The house should be washed down with water and scrubbed out well A lye solution makes cleaning somewhat easier

A recent development in brooding has been the reuse of the litter which has already been used for rearing a flock of chicks This is directly contrary to what has been the practice in the

past when cleanliness was considered an essential. Results under experimental and practical conditions have been reasonably satisfactory, but there is little evidence to indicate that better chickens can be grown under this system than under the old method, provided a good ration is used in both cases. There is danger of blinding the chicks if excess ammonia is released from the litter. If a poor quality ration is used, chicks will do better on old litter since apparently it furnishes certain vitamins through bacterial action. Perhaps this new system should be avoided unless one is an experienced poultryman or until more is known about its limitations and dangers.

After thorough cleaning, the walls and floors should be disinfected with a creosote solution. Since these solutions vary considerably in their strength, it is well to follow the manufacturer's directions. At this time also the perches and roost supports should be painted with carbolineum or crankcase oil. A 5 per cent solution of DDT and kerosene is also quite effective. The purpose of this treatment is to control the red mites. It is an unusual poultry house that doesn't have a few of them present. Be careful when using the carbolineum and creosote disinfectants, since they are apt to burn the skin. This treatment should be done well in advance of the time the chicks are expected, since fumes from the disinfectant or carbolineum occasionally will cause mortality among the chicks.

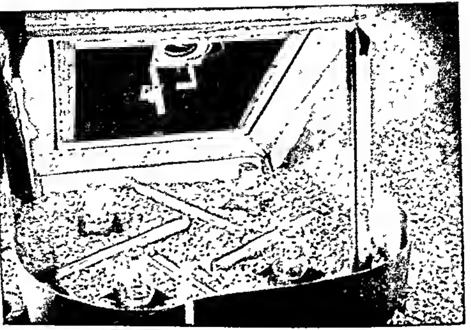
The heating apparatus, regardless of its kind, should be overhauled and operated for a short time to be sure that it is in good working order. Delay may result in inability to get replacement parts. The thermostat should be checked to see if it is operating normally. Many different products can be used for litter, but wood shavings, sugar-cane fiber, ground corn cobs, and finely cut straw are generally preferred. They should be free from dust and mold. It is desirable to keep the poultry litter dry. A common practice has been to add additional litter as the original litter becomes broken up. This results in a deep, built up litter which need not be changed during the brooding and rearing period. Observation indicates that a deep, dry litter which may contain considerable amounts of droppings is better than a fresh litter which is thin and which readily becomes damp. This practice is contrary to what has been used for many years, but it seems to be giving very satisfactory results.

Starting the chicks. During the first three or four days to a week, chicks should be confined to the brooder area by means of a chick guard This can be of metal, half inch hardware cloth, or corrugated cardboard This guard is usually 15 to 18 inches high and is placed in a circle around the hover so as to keep the chicks near the heated area If electric brooders are used, the guard should be of a draftproof type, such as metal or corrugated cardboard If gas, wood, or coal brooders are used, the wire mesh is quite satisfactory With electric brooders this guard should be placed within 6 inches or 1 foot of the edge of the hover, one portion of it touching the hover With the other types of brooders, the guards can be 2 to 3 feet from the edge of the hover This distance should be increased gradually as the chicks become trained to use the hover, and the guard can be removed entirely at a week or ten days Many poultry men place cardboard or metal in the corners of the house to prevent the chicks from piling up, or place the litter in the corners to serve the same purpose

The small feeders should be placed spokelike under the edge of the hover In the case of the electric brooder, the feeder should be under the hover for the first few days Later on, the feeders are moved out from under the edge of the hover and at a week or ten days should be replaced with larger feeders Some poultrymen feed the birds on egg flats during the first few days to encourage them to eat Allow one 24-inch feeder and a 1 quart water fountain for each 50 chicks

If the birds are to be reared on range, they should be given access to the ground as soon as possible, as determined by the weather A low fence can be placed in front of the house and feed and water placed in the yard to encourage the chicks to come outdoors Within a few days to a week they will have learned how to return to the house, and then the fence can be removed and the chicks allowed to range The original yard should be about the same floor area as the brooder house itself

There are a number of management factors to consider during the rearing period These include separating the cockerels from the pullets, vaccinating for such diseases as fowl pox and Newcastle disease, and possibly dubbing the cockerels (removing the combs and wattles to prevent freezing)

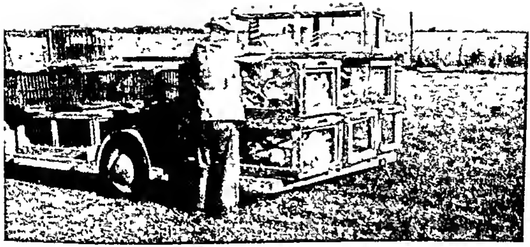


A commercial electric brooder ready for baby chicks. The feeders and waterers are under the hover and the chick guard is drawn close.

Separating the sexes. It has been pointed out earlier that one purpose in separating the sexes at eight to twelve weeks is to give the birds more room. Another reason is that the larger males dominate the pullets and prevent the latter from obtaining enough feed. Then, too, the birds begin to mate and the smaller pullets are likely to be injured or killed. If some of the cockerels are to be retained for breeding, the best ones can be allowed to run with the pullets, but not to exceed the ratio of one cockerel to twenty pullets. If the cockerels are kept by themselves they will fight and some will be killed, but this is the general practice on most farms.

Vaccination. Vaccinating is an important part of the disease-prevention program on many farms. The most common diseases controlled in this way are fowl pox and Newcastle disease. In a few areas a program of immunization against bronchitis and laryngotracheitis is also followed. The usual age for vaccinating for all of these is between the tenth and sixteenth week.

Dubbing. In the areas where the temperature in the poultry house is apt to go below 15° F., a quite common practice is



Bringing pullets to the laying house. A low-wheeled trailer is useful on any farm.

to dub the breeding males to prevent freezing the head furnishings. The removal of the comb and wattles is best done when the birds are about eight to ten weeks old. A warm, dry day should be selected. The comb and wattles are merely cut off by means of shears or scissors. There will be little or no loss of birds from the operation and it is a good insurance against frozen combs and wattles during the cold weather. The practice is also followed where there is no danger of freezing because it reduces the loss from fighting.

SUGGESTIONS AND QUESTIONS

1. Draw plans of an A-type range shelter, work out a bill of material, and construct a scale model. The building of the model will enable you to find ways of improving the construction through simplification and lowering costs by using material of a size which reduces waste. It may be desirable to build several models before undertaking the construction of a full-size unit.

2. Obtain plans of colony houses and permanent brooder houses from your state agricultural college, using local prices, determine the cost of a comparable brooding capacity. The same procedure should be followed for comparing costs of the heating equipment using coal, oil, and electric brooders and a permanent heating system.

3. Visit six or more farms in your area where farm flocks of 75 to

200 hens are kept. Prepare a record sheet and record the methods of brooding used, the size and style of house, the floor space per chick, the heat unit used, the distance from the laying house, and other points of importance. How do your findings compare with the material discussed in the previous chapter? If possible, repeat the survey on a few commercial poultry farms.

4. Prepare an inventory of equipment and housing needed to rear 250 straight run chicks. Determine how much feed will be needed and the cost. Dispose of the cockerels at nine weeks if they are Leghorns and at twelve weeks if they are one of the heavy breeds.

5. Write to poultry equipment manufacturers and obtain catalogs. Compare the equipment as regards specifications and prices. Addresses may be obtained from poultry journals. Visit local dealers who stock different makes of equipment and compare the apparent quality of the lines.

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CHAPTER 9

Growing Young Stock

HOW A CHICK GROWS

THE AIM of a chick ration is to produce normal growth. Growth or the weight of a bird is a reliable measure of its health and condition. Furthermore, weight is a measure which can be easily obtained and can be used as a guide in feeding.

Normal growth refers to the weights, limited by inheritance, which the birds should attain when kept under favorable conditions. It is necessary to keep in mind, however, that the rate of growth is subject to variation, depending upon breeding, management, and environmental conditions. Hence, there are definite standards for each variety or strain which has a different weight at maturity.

The rate of growth of chickens conforms in general to the same principle of growth shown to be true for other animals, namely, that growth is greatest in the earliest period of life, decreases rapidly for a time, and then more slowly as maturity is approached.

The feeding and the management influence the rate of growth at different periods. Rations low in protein will result in slow early growth of the chick. This can be made up within certain limits in later periods, however, so that with the same breeding the final mature weight of such chicks will be approximately the same as of chicks which grew faster at the start, in which case later growth is relatively not so rapid.

Actual weights which will be reached by chicks at different ages vary with the breed, rations, and the conditions under

which they are reared Chicks confined, especially in batteries, will grow more rapidly than chicks running outdoors

Growth information for chicks reared on range is presented in Tables 33, 34, and 35

TABLE 33 AVERAGE BIWEEKLY WEIGHTS OF CHICKS AT CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION (1932)

AGE	SINGLE-COMB WHITE LEGHORNS				AMERICAN BREEDS			
	Cockerels		Pullets		Cockerels		Pullets	
	Pounds	*Ounces*	*Pounds*	*Ounces*	*Pounds*	*Ounces*	*Pounds*	*Ounces*
Day old	0	1 4	0	1 4	0	1 4	0	1 4
2 weeks	0	3 5	0	3 1	0	3 0	0	2 9
4 weeks	0	7 7	0	6 2	0	7 4	0	6 8
6 weeks	0	13 1	0	10 8	0	15 3	0	13 3
8 weeks	1	5 3	1	1 4	1	8 8	1	4 6
10 weeks	1	14 3	1	7 3	2	1 4	1	9 4
12 weeks	2	5 6	1	11 4	2	12 9	2	2 0
14 weeks	2	12 7	2	1 3	3	9 2	2	9 6
16 weeks	3	2 9	2	6 3	4	0 3	3	0 6
18 weeks	3	7 2	2	11 1	4	10 1	3	7 5
20 weeks	3	12 0	2	15 8	5	0 2	3	11 7
22 weeks	3	15 7	3	3 1	5	7 0	3	15 4
24 weeks	4	3 1	3	5 8	5	8 8	4	4 3
26 weeks	4	9 2	3	7 5	5	10 4	4	7 8
28 weeks	4	12 5			6	1 1		
30 weeks	4	13 8			6	10 1		
32 weeks					6	11 5		

(Cornell University Extension Bulletin 240)

TABLE 34 WEIGHTS OF SINGLE-COMB WHITE LEGHORNS, AT FIVE AGRICULTURAL EXPERIMENT STATIONS

PLACE	AT 8 WEEKS OF AGE				AT 12 WEEKS OF AGE				AT 24 WEEKS OF AGE			
	Male		Female		Male		Female		Male		Female	
	Pounds	Ounces	Pounds	Ounces	Pounds	Ounces	Pounds	Ounces	Pounds	Ounces	Pounds	Ounces
Connecticut [1]	[1]	[1]	[1]	[1]			1	12 8			3	4 5
Illinois [2]	1	1 8		15 6	1	15 1	1	10 1	3	12 5	3	0 7
Kentucky [3]	1	4 5	1	2 9	2	0 7	1	14 0	3	7 9	3	3 4
Pennsylvania [4]			1	1 7			1	11 0				
Pennsylvania [5]	1	1 5		15 4							3	1 3
Rhode Island [6]	1	0 5		14 5	1	13 5	1	8 0	3	15 0	3	3 3

[1] From Card and Kirkpatrick (1918) Note 1 pound 1 4 ounces is the average weight for both males and females.
[2] From Kempster (1926).
[3] From Buckner Willms, and Kastle (1918)
[4] From Charles and Knandel (1928)
[5] From Funk, Knandel and Callenbach (1930)
[6] From Waters (1931) Data in months.

(Cornell University Extension Bulletin 240)

TABLE 35 WEIGHTS OF AMERICAN BREEDS, AT EIGHT AGRICULTURAL EXPERIMENT STATIONS

PLACE	At 8 Weeks of Age				At 12 Weeks of Age				At 24 Weeks of Age			
	Male		Female		Male		Female		Male		Female	
	Pounds	Ounces	Pounds	Ounces	Pounds	Ounces	Pounds	Ounces	Pounds	Ounces	Pounds	Ounces
	Rhode Island Reds											
Connecticut [1]	[1]	[1]	[1]	[1]	[1]	[1]	[1]	[1]			4	4 7
Massachusetts [2]									5	4 6[3]	4	3 2[3]
North Carolina [4]	1	3 7	1	1 3	2	5 0	1	15 0	5	7 8	4	7 2
United States Department of Agriculture [5]												
Milk	1	7 5	1	4 4	2	14 6	2	5 0	5	13 5	4	9 2
No milk		14 9		12 4	1	15 0	1	9 6	5	10 3	4	2 3
	Rhode Island Whites											
Missouri [6]	1	1 7		15 2	2	1 6	1	11 0	5	7 7	3	13 5
	White Plymouth Rocks											
Illinois [7]	1	0 8		14 7	1	9 3	1	5 2	3	9 7	3	1 5
Indiana [8]		[8]		[8]	2	13 8	2	4 5	6	6 9	5	0 2
Missouri [6]		13 4		11 9	1	10 5	1	5 8	5	9 6	4	4 1
	Barred Plymouth Rocks											
Missouri [6]	1	0 2		15 1	2	1 7	1	8 8	5	10 1	3	15 0
Pennsylvania [9]	1	4 2	1	2 4			2	2 1				
	Buff Plymouth Rocks											
Missouri [6]	1	3 5	1	1 1	2	1 0	1	13 0	5	12 7	4	1 6

[1] From Card and Kirkpatrick (1918) Note 1 pound 3 6 ounces and 2 pounds 4 6 ounces are the average weights for both males and females at 8 and 12 weeks of age respectively
[2] From Hays and Sanborn (1929)
[3] Twenty-one weeks.
[4] From Kaupp (1921)
[5] From Titus and Jull (1928)
[6] From Kempster (1926)
[7] From Mitchell, Card, and Hamilton (1926)
[8] From Phillips (1918) Note 1 pound 4.5 ounces is the average weight for both males and females.
[9] From Charles and Knandel (1928)

(Cornell University Extension Bulletin 240)

Cockerels grow more rapidly than pullets There is not much difference between Leghorns and the American breeds until the birds weigh about a pound After that time the heavy breeds make the greater gains

The mature weight of the males is greater than that of the females Very little, if any, difference exists in the weights of

which they are reared Chicks confined, especially in batteries, will grow more rapidly than chicks running outdoors.

Growth information for chicks reared on range is presented in Tables 33, 34, and 35

TABLE 33 AVERAGE BIWEEKLY WEIGHTS OF CHICKS AT CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION (1932)

AGE	SINGLE-COMB WHITE LEGHORNS				AMERICAN BREEDS			
	Cockerels		Pullets		Cockerels		Pullets	
	Pounds	*Ounces*	*Pounds*	*Ounces*	*Pounds*	*Ounces*	*Pounds*	*Ounces*
Day old	0	1 4	0	1 4	0	1 4	0	1 4
2 weeks	0	3 5	0	3 1	0	3 0	0	2 9
4 weeks	0	7 7	0	6 2	0	7 4	0	6 8
6 weeks	0	13 1	0	10 8	0	15 3	0	13 3
8 weeks	1	5 3	1	1 4	1	8 8	1	4 6
10 weeks	1	14 3	1	7 3	2	1 4	1	9 4
12 weeks	2	5 6	1	11 4	2	12 9	2	2 0
14 weeks	2	12 7	2	1 3	3	9 2	2	9 6
16 weeks	3	2 9	2	6 3	4	0 3	3	0 6
18 weeks	3	7 2	2	11 1	4	10 1	3	7 5
20 weeks	3	12 0	2	15 8	5	0 2	3	11 7
22 weeks	3	15 7	3	3 1	5	7 0	3	15 4
24 weeks	4	3 1	3	5 8	5	8 8	4	4 3
26 weeks	4	9 2	3	7 5	5	10 4	4	7 8
28 weeks	4	12 5			6	1 1		
30 weeks	4	13 8			6	10 1		
32 weeks					6	11 5		

(Cornell University Extension Bulletin 240)

TABLE 34 WEIGHTS OF SINGLE COMB WHITE LEGHORNS, AT FIVE AGRICULTURAL EXPERIMENT STATIONS

PLACE	AT 8 WEEKS OF AGE				AT 12 WEEKS OF AGE				AT 24 WEEKS OF AGE			
	Male		Female		Male		Female		Male		Female	
	Pounds	Ounces	Pounds	Ounces	Pounds	Ounces	Pounds	Ounces	Pounds	Ounces	Pounds	Ounces
Connecticut [1]	[1]	[1]	[1]	[1]			1	12 8			3	4 5
Illinois [2]	1	1 8		15 6	1	15 1	1	10 1	3	12 5	3	0 7
Kentucky [3]	1	4 5	1	2 9	2	0 7	1	14 0	3	7 9	3	3 4
Pennsylvania [4]			1	1 7			1	11 0				
Pennsylvania [5]	1	1 5		15 4							3	1 3
Rhode Island [6]	1	0 5		14 5	1	13 5	1	8 0	3	15 0	3	3 3

[1] From Card and Kirkpatrick (1918) Note 1 pound 1 4 ounces is the average weight for both males and females.
[2] From Kempster (1926)
[3] From Buckner Wilkins, and Kastle (1918)
[4] From Charles and Knandel (1928)
[5] From Funk, Knandel, and Callenbach (1930)
[6] From Waters (1931) Data in months.

(Cornell University Extension Bulletin 240)

according to the laws of growth Growth represents increase in such tissues as bones, muscle, skin, feathers, and nerves

GROWTH RELATIONS

Rate of gain The manner in which a chick grows is interesting The rates of gain of four lots of birds are presented in the top chart on page 292 The data shown give the percentage rate of gain at each biweekly weighing on the basis of the previous weight The relative gains are large for the early growth period and are very high for the first six weeks They decline sharply during the next six weeks after which time the decrease is more gradual until maturity is reached This growth is more rapid than in the case of any other farm animal Although the average chick will double its weight in about ten days sometimes an individual will do this within a week It will probably never again double its weight within a like period of time, however

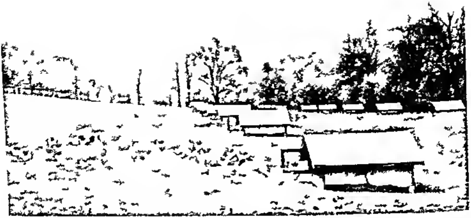
There is more danger of trouble when the growth is relatively rapid Therefore, the greatest possibilities of trouble occur during early life If the chicks can be successfully reared to two months of age, most of the danger is passed

Actual gains As far as actual gains are concerned considerable variation exists from period to period The tendency, however, is for the actual gains to increase until the chicks are about three months of age, after which time there is a general decrease in the rate of gain This is shown in the bottom chart on page 292

The relations mentioned have a bearing upon the time to market broilers and roasters As long as the birds are growing relatively fast and making good actual gains, it is more economical to hold them, in order to take advantage of the rapid growing period

FOOD RELATIONS

Food consumption is closely related to growth The amount of food consumed increases with the increase in the size of the bird Since the rate of growth is rapid at the start, the gains per unit of food are larger early in life A larger proportion of the food goes into growth Therefore, the number of pounds of



U.S.D.A. photograph by Forsythe

Free ranges of bluegrass and timothy on this 100-acre New Jersey poultry farm support thousands of vigorous healthy pullets

males and females at hatching time Thus there exist differential growth curves for female and male chicks According to reports the Barred Plymouth Rock females grow slower than the males after the first few weeks For the first two months the females average 80 to 90 per cent of the male weight after that time they will average 75 to 80 per cent of the male weight.

A difference exists in the mature weight of the various breeds There probably exist differential growth curves for chicks of the light breeds as compared with chicks of the heavy breeds The heavier breeds have a relatively larger rate of growth than that of the lighter breeds during the early period or the first two to three months After that time, there is very little difference in the percentage rates of gain between the different breeds

The time of hatching and environmental conditions influence growth Early hatched chicks have a tendency to grow faster than late hatched chicks

In the case of the young stock energy is thrown into growth and motion If either one is stopped for any period of time the results will not be favorable Both must continue steadily

feed required to produce a pound of gain is relatively low in early life and increases as the chicks grow older More economical gains are made when the chicks are growing rapidly. This statement is shown in the following figures which give the amount of feed required to produce one pound of gain at different ages

Period	*Pounds of Feed to Produce 1 Pound of Gain*
Day old–2 weeks	3 11
10–12 weeks	5 84
20–22 weeks	11 40

Most poultrymen prefer to secure relatively rapid early growth in chicks There are a number of advantages to be gained by this procedure, such as maintained vitality and body reserve, earlier broiler marketing, and sufficient body weight of pullets at the time of sexual maturity to promote good egg size and continued production

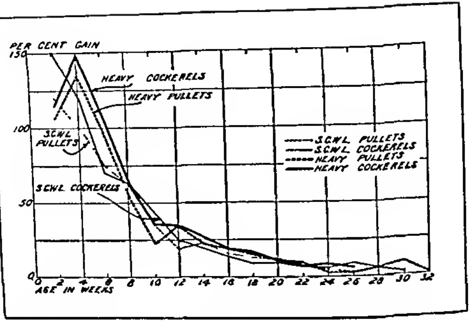
REQUIREMENTS OF THE RATION FOR GROWTH

The increases in body weight of the chick during early life represent chiefly increases in water, protein, and mineral matter In order to obtain satisfactory growth, the ration must be complete and must contain sufficient amounts of the various nutrients

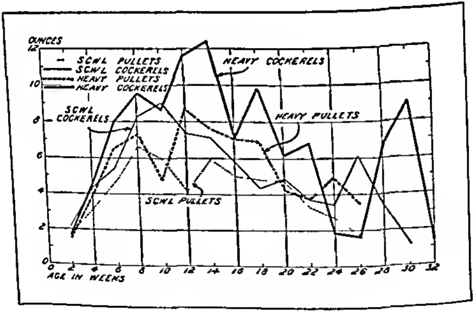
Protein. Protein refers to the nitrogenous part of the ration and functions in building muscles, nerves, feathers, blood, and internal organs

Various investigators have pointed out that the protein requirements of different species of animals are more or less proportionate to the rate of growth One investigator has shown that in the case of mammals the rate of growth is proportional to the protein in the natural food or milk as indicated by the length of time required for the newborn animal to double its initial weight

It has also been pointed out by various authorities that the requirements of chicks are greater than the protein needs of laying hens The unabsorbed yolk material which is present in the chick at the time of hatching and which acts as its first food supply contains a large amount of protein When we consider



Rate of gain at each biweekly weighing on the basis of the previous weight



Actual biweekly gains in weight

Healthy day-old chicks with plenty of room and equipment.

ments the actual levels might be changed to some degree, although the relative facts just presented will undoubtedly still hold.

Therefore, in supplying protein in the chick ration, we should aim to include enough to promote satisfactory growth for the age with which we are dealing. An excess will not harm the chick but will not give added benefit, and it is not economical. A ready guide for the probable amounts is as follows: The ration should contain 19 to 20 per cent protein for the first month, depending upon the quality of protein. This can be decreased approximately 2 per cent each month thereafter but should never be less than 14 per cent. These figures apply to the entire ration and should take into consideration the grain, as well as the mash, consumed.

Vitamins. Vitamins are an important part of the feed. A number of them are necessary for chick growth and the maintenance of health. Some must be given special consideration in the ration because of their special importance and because they occur in large amounts in a limited number of natural feeding stuffs rather than being more or less widely distributed.

the wild birds, we notice that the young are fed very largely on grubs and worms, which are largely protein In the case of those species of birds which grow relatively fast, we also find that their rations must contain larger amounts of protein in order to accomplish this faster growth

Growth and the accompanying protein requirements of chicks may be divided into three periods The first period, calling for rapid growth and a high protein level, includes approximately the first month or six weeks The second period, during which growth is less rapid and during which the protein level can be decreased, extends from the end of the first period to about three months The third period, during which growth is further slowed down and during which the protein level can be again decreased to some extent, continues from the end of the second period until the end of the growing period

Results from a number of experiment stations indicate that the early rate of growth of chicks is increased as the protein level is increased to about 20 per cent, that lots receiving low protein rations weigh less throughout the growing period, that mortality is usually increased in the low protein lots, and that the amount of protein can be decreased as the chicks grow older It has also been reported that feather pulling, tail picking, and cannibalism have developed in low protein pens as early as the second and third week Feather eating and pickouts have also been observed in low protein pens On the other hand, at least one experiment station reports that a pathological examination of birds at 38 weeks of age showed that the high protein rations were not injurious in their effects when fed up to this age as judged by the conditions of the liver, spleen, heart, and kidneys.

The results of all trials up to the present time indicate that to obtain early rapid growth the ration should contain approximately 19 to 20 per cent protein for the first period of growth During the second period, the level appears to be about 17 to 18 per cent protein Afterwards a ration containing 15 to 16 per cent protein meets the requirements for the rest of the growing period The indications are also that the ration should never contain much less than 15 per cent protein These figures apply to rations containing meat scrap and milk as the chief source of protein With other protein supple

rations composed of a variety of natural feeding stuffs of high quality seem to furnish enough of these factors It is only with restricted rations and under special conditions that they might need specific supplementation

Minerals A number of minerals are necessary Most of these are furnished in ample amounts in good rations Of the minerals, calcium and phosphorus are needed in largest amounts for bone formation The chick ration should contain 0 6 to 0 8 per cent of phosphorus and twice that amount of calcium At least 0 4 per cent of the phosphorus should come from inorganic sources It is best to maintain a ratio of calcium to phosphorus of approximately two to one Possibly, however, this may extend over a range of 1 5 1 to 2 5 1

Large amounts of total minerals in the ration are not desirable The maximum levels which it seems wise to include in chick rations are 1½ per cent of calcium and 1 per cent of phosphorus

Sufficient manganese must be present to prevent slipped tendons, or perosis The requirement for chicks is about 30 to 50 parts per million of feed For an average ration the addition of one quarter pound of manganese sulfate per ton will supply a sufficient quantity

Recommended allowances The Animal Nutrition Committee of the National Research Council has issued recommended allowances for poultry rations These differ from requirements, which refer to actual amounts needed at the time of consumption, in that margins of safety are provided to take care of variation in the nutrient content of feedstuffs, variation in feed requirements, and vitamin destruction during reasonable periods of storage

The recommended nutrient allowances for young chickens are given in Table 36

Fat The ration should contain a moderate amount of fat The usual recommendation in this respect is 4 to 5 per cent

Fiber Because fiber is not digestible, the general feeling is that the fiber content of chick rations should not be too high, especially since fibrous feeds also increase the bulk Good results have been reported with rations containing widely varying amounts of fiber, ranging from 1 to 10 per cent However,

Vitamin A is essential for optimum growth and for the prevention of so-called nutritional roup The chick ration should contain, at the time of consumption, a minimum of 1100 to 1300 International Units of vitamin A per pound of feed In chick rations vitamin A is furnished in yellow corn, green feeds alfalfa meal, and fish oils

Thiamine, although essential for chicks, is usually not deficient under ordinary conditions, because it is abundant in cereals and green feeds If the ration is made up of 30 to 40 per cent of cereals and cereal by products, sufficient vitamin B_1, or thiamine, will be supplied

Vitamin D is necessary for calcium utilization and hence for bone formation A lack of this vitamin will result in rickets Exposure to direct sunshine enables the bird to synthesize vitamin D If the birds are not exposed to direct sunshine or to artificially produced ultraviolet irradiation, it will be necessary to use some vitamin D carrier One hundred thirty five International Units of vitamin D per pound of feed will give very satisfactory results

Riboflavin is essential for the promotion of growth and the prevention of nutritional paralysis The amount required will depend upon the age and growth of the birds During the first two weeks the requirement is high, namely, 300 to 350 micrograms per 100 grams of feed (1350 to 1575 per pound) The requirement is highest early in life when the rate of growth is most rapid, but decreases as the chick grows older After two months of age the requirement is met by feeding a ration containing 100 micrograms per 100 grams of feed (450 per pound) When fed a constant amount of riboflavin over a period of eight weeks, 290 micrograms of riboflavin per 100 grams of feed (1300 per pound) have been reported as being necessary This amount will be furnished in a practical ration containing 8 to 10 per cent of dried skim milk or its equivalent

Pantothenic acid is necessary to prevent chick dermatosis or pellagra The requirement of about 500 to 600 micrograms per 100 grams of feed is usually met in good practical rations which will contain at least twice this amount

Other vitamins are essential, but the information concerning quantitative requirements for them is not available Good

rations composed of a variety of natural feeding stuffs of high quality seem to furnish enough of these factors It is only with restricted rations and under special conditions that they might need specific supplementation

Minerals. A number of minerals are necessary Most of these are furnished in ample amounts in good rations Of the minerals, calcium and phosphorus are needed in largest amounts for bone formation The chick ration should contain 0 6 to 0 8 per cent of phosphorus and twice that amount of calcium At least 0 4 per cent of the phosphorus should come from inorganic sources It is best to maintain a ratio of calcium to phosphorus of approximately two to one Possibly, however, this may extend over a range of 1 5 1 to 2 5 1

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Recommended allowances The Animal Nutrition Committee of the National Research Council has issued recommended allowances for poultry rations These differ from requirements, which refer to actual amounts needed at the time of consumption, in that margins of safety are provided to take care of variation in the nutrient content of feedstuffs, variation in feed requirements, and vitamin destruction during reasonable periods of storage

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Fat The ration should contain a moderate amount of fat The usual recommendation in this respect is 4 to 5 per cent

Fiber Because fiber is not digestible, the general feeling is that the fiber content of chick rations should not be too high, especially since fibrous feeds also increase the bulk Good results have been reported with rations containing widely varying amounts of fiber, ranging from 1 to 10 per cent However,

TABLE 36 NATIONAL RESEARCH COUNCIL RECOMMENDED NUTRIENT ALLOWANCES FOR YOUNG CHICKENS (AMOUNT PER POUND OF FEED)

NUTRIENT	0-8 WEEKS	8 18 WEEKS
Protein (per cent)	20	16
Vitamins		
Vitamin A activity (I U [1])	2000 0	2000 0
Vitamin D (I C [2] Units)	135 0	135 0
Thiamine (mg [3])	0 9	?
Riboflavin (mg)	1 6	9
Pantothenic acid (mg)	5 0	5 0
Niacin (mg)	8 0	?
Pyridoxine (mg)	1 6	?
Biotin (mg)	0 045	?
Choline (mg)	700 0	?
Minerals		
Calcium (per cent)	1 0	1 0
Phosphorus (per cent) [4]	0 6	0 6
Salt (per cent) [5]	0 5	0 5
Manganese (mg)	25 0	?
Iodine (mg)	0 5	0 5
Potassium (per cent)	0 2	0 16

[1] May be fish oil v amin A or provitamin A from vegetable sources.
[2] In ernational Chick.
[3] M ll grams.
[4] Inorgan c phosphorus should cons tute 0 4 per cent of the total feed
[5] This figure represents added salt or sod um chloride

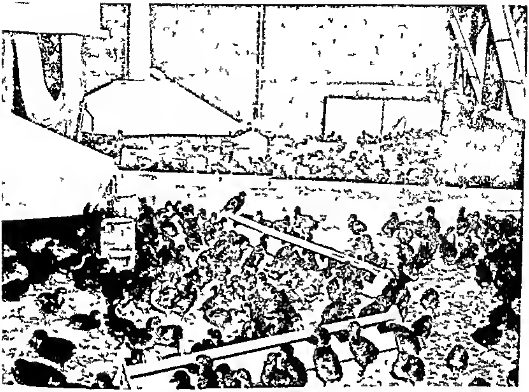
feather picking is usually worse in the low fiber lots Most of the good rations do not exceed 6 to 8 per cent of fiber High energy rations, especially those for broilers, contain less than this amount

Other considerations It is important that a good supply of fresh, clean water be kept constantly available

A hard, insoluble grit should be fed, especially if the chicks are not running on a gravelly range

The feeds should be palatable in order to encourage food consumption In compounding a ration those feeds which are processed the least and which represent more nearly the whole product are safest to use The feed must not be too bulky or the actual food intake will be restricted, and growth will be retarded Neither should the feed be too concentrated To enable all the chicks to get sufficient feed, enough feeding space must be provided by the right kind of hoppers

If grains are fed, they must be of such size as to suit the age of the chicks Ground feeds should be neither too fine nor too coarse The mash should not contain large particles, such



Chicks in a brooder house. Notice the feeders and waterers.

as oat hulls or unsifted meat scraps, but should be uniform in texture.

HOW THE NUTRIENTS ARE SUPPLIED

In the natural state the nutrients are supplied by a diet consisting of grains, seeds, insects, worms, and green feeds The average chick ration is now made up very largely of cereals and cereal by-products, supplemented with certain protein, vitamin, and mineral additions. Many successful combinations have been fed.

The right kind or quality of protein is supplied by the use of animal-protein feeds, such as meat scraps, fish meal, and milk. Part of the animal protein can be replaced by vegetable protein, such as soybean protein, corn gluten protein, peanut protein, and cottonseed protein.

Vitamin A is supplied mainly in the yellow corn and alfalfa meal, in fish oil when fed, and in the green feed consumed when on range. Thiamine occurs in the various cereals used

in the ration Vitamin D is provided by fish oils, activated animal sterols, or exposure to ultraviolet rays or sunshine Riboflavin is usually furnished by the milk products, alfalfa meal, green feed, or fermentation and distillation by products Vitamin B_{12} is supplied by animal protein feeds and special fer mentation products

Where the usual amounts of animal protein concentrates are used, sufficient phosphorus is present If necessary to add phosphorus, bone meal or defluorinated calcium phosphate are used Calcium, however, is likely to be low and is provided by adding some calcium carrier, such as pulverized limestone or oystershell

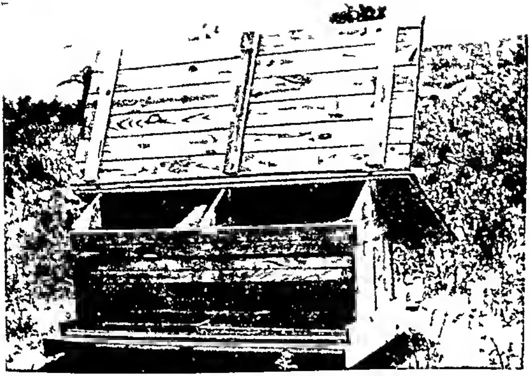
FEEDING PRACTICES

Time of first feed It has been shown that early feeding of chicks is not harmful Withholding feed too long, however, will cause the chicks to pick up litter to satisfy their hunger In general, chicks may be fed as soon after hatching as they care to eat with no harmful results upon weight or mortality Further, they should be fed not later than 36 to 48 hours after hatching although they can go much longer periods before receiving their first feed

Feeding methods There has been a general tendency to feed chicks all mash rations Some poultrymen feed grain only for the first two days believing that it will help to prevent pasting up Grain mash rations are also used, as well as modi fied rations in which the all mash is fed as a starting mash, supplemented later with grain

During the early periods when growth is rapid there is a greater requirement for protein minerals, and vitamins Ex cesses may or may not be detrimental but are usually not eco nomical Therefore when using all mash or grain mash ra tions, it is desirable, if not necessary, to have two or three different mixtures to cover the growing period

In order to furnish a large amount of protein and some of the other nutrients at the start, a common practice is to feed an all mash ration for at least four to six weeks, after which time grain is also fed Since the grain contains much less pro tein and other nutrients than the mash and since the birds will consume increasing amounts of the grain, the protein



A good outdoor feeder saves feed and time This feeder has separate compartments for mash and grain The throat is adjustable

U.S.D.A photograph by Forsythe

Pullets in shelters on range Grain from the Middle West means plenty of feed for chickens in the Northeast.

and some other nutrients of the ration are thus automatically reduced in the later periods

This method provides the use of a single mixture for both a starting and growing mash. Some poultrymen prefer feeding grain at an earlier age. In that case it should be fed sparingly at first, or, if fed heavily, the ration should be modified, such as increasing the proportion of meat and milk in the mash or supplementing with liquid or condensed milk. About equally favorable results can be obtained from grain mash rations, all mash rations, and modifications of these two systems if the nutrients are properly provided

Amount of feed. Free choice of food is usually allowed growing chicks since there is little possibility of overfeeding in the early stages of growth if the ration is properly compounded. Sufficient and proper feeding space must be provided so that the birds can consume enough feed

Usually the birds are allowed to eat what they wish during the entire growing period. When both grain and mash are fed, it might be necessary at times to restrict one or the other

The amounts of food given in Table 37 have been suggested

TABLE 37 FOOD REQUIREMENTS OF THE GROWING FOWL (POUNDS PER DAY PER 100 BIRDS)

MONTH OF LIFE	LIGHT BREEDS		HEAVY BREEDS	
	Females	Males	Females	Males
1	4 4	4 7	4 9	5 1
2	8 6	9 3	9 8	10 7
3	12 6	13 8	15 4	16 8
4	16 1	17 7	20 0	22 4
5	18 2	20 3	24 0	26 3
6	18 9	21 4	24 9	29 1

as the probable average quantities required, but these will be modified by the rate of growth

The figures in Tables 38 and 39 give the food consumption for flocks of chicks reared under average outdoor range conditions

TYPICAL GOOD CHICK RATIONS

The most commonly practiced method of feeding chicks is to use an all mash ration as a starter and then supplement this

TABLE 38 AVERAGE WEEKLY FOOD CONSUMPTION, IN POUNDS PER 100 BIRDS (SINGLE-COMB WHITE LEGHORNS)

Week	Grain	Mash	Grain and Mash	Total to Date	Grain	Mash	Grain and Mash	Total to Date
	Pullets and cockerels				Pullets and cockerels			
1		14.9	14.9	14.9	1.7	10.5	12.2	12.2
2		21.5	21.5	36.4	6.8	11.9	18.7	30.1
3		29.0	29.0	65.4	6.1	23.1	29.2	60.1
4		37.5	37.5	102.9	13.6	24.6	38.2	98.3
5		50.1	50.1	153.0	16.4	33.4	49.8	148.1
6		57.4	57.4	210.4	16.0	35.3	51.3	199.4
	Pullets only							
7		71.9	71.9	282.3	21.5	55.8	77.3	276.7
8		64.5	64.5	346.8	27.3	67.5	94.8	371.5
9	27.8	71.6	99.4	446.2	31.1	80.5	111.6	483.1
10	29.4	52.0	81.4	527.6	41.6	84.5	126.1	609.2
					Cockerels only			
11	20.7	64.2	84.9	612.5	62.6	65.8	128.4	737.6
12	42.8	64.2	107.0	719.5	89.8	39.6	129.4	867.0
13	40.8	68.5	109.3	828.8	94.3	40.8	135.1	1,002.1
14	49.3	58.9	108.2	937.0	66.9	60.8	127.7	1,129.8
15	59.2	54.0	113.2	1,050.2	44.9	58.0	102.9	1,232.7
16	57.4	58.6	116.0	1,166.2	74.3	53.9	128.2	1,360.9
17	54.4	60.7	115.1	1,281.3	91.6	69.4	161.0	1,521.9
18	70.9	47.1	118.0	1,399.3	71.6	54.7	126.3	1,648.2
19	55.0	48.9	103.9	1,503.2	105.5	46.7	152.2	1,800.4
20	71.2	38.0	109.2	1,612.4	62.0	75.3	137.3	1,937.7
21	85.2	42.7	127.9	1,740.3	86.7	48.2	134.9	2,072.6
22	80.1	35.1	115.2	1,855.5	111.0	44.3	155.3	2,227.9
23	78.4	46.3	124.7	1,980.2	118.4	43.5	161.9	2,389.8
24	77.2	49.4	126.6	2,106.8	119.6	50.2	169.8	2,559.6
25	95.8	44.2	140.0	2,246.8	133.2	24.9	158.1	2,717.7
26	76.7	54.4	131.1	2,377.9	153.3	49.1	202.4	2,920.1
27					110.5	42.4	152.9	3,073.0
28					121.2	50.9	172.1	3,245.1
29					176.1	22.4	198.5	3,443.6
30					186.2	21.8	208.0	3,651.6
Total	1,072.3	1,305.6	2,377.9		2,260.8	1,388.8	3,651.6	

(Cornell University Extension Bulletin 240.)

with grain later. In Table 40 are presented recommended formula patterns of rations for young chickens.

The choice of the components of the cereal portion of the mash will be determined largely by price and availability. Feeding experience has shown that the best ration is a mixture of cereal products rather than one grain or grain product.

TABLE 39 AVERAGE WEEKLY FOOD CONSUMPTION, IN POUNDS PER 100 BIRDS (AMERICAN BREEDS)

Week	Grain	Mash	Grain and Mash	Total to Date	Grain	Mash	Grain and Mash	Total to Date
	Pullets and cockerels							
1		11 2	11.2	11 2				
2		17 9	17 9	29 1				
3		28 4	28 4	57 5				
4		40 2	40 2	97 7				
5		57 7	57 7	155 4				
6		72 7	72.7	228 1				
7		84 9	84 9	313 0				
8		100 3	100 3	413 3				
9	15 3	101 4	116 7	530 0				
10	31 3	86 1	117 4	647 4				
11	58 1	76 7	134 8	782 2				
12	71 3	68 8	140 1	922 3				
13	81 9	57 7	139 6	1,061 9				
14	76 4	51 8	128 2	1,190 1				
	Pullets only				Cockerels only			
15	73.2	57 1	130 3	1,320 4	112 4	84 9	197.3	1,387 4
16	92 8	44 1	136 9	1,457 3	107 3	73 3	180 6	1,568 0
17	93 9	54 4	148 3	1,605 6	119.2	70 0	189 2	1,757.2
18	88 6	44 4	133 0	1,738 6	112 4	61 0	173 4	1,930 6
19	83 6	45 3	128 9	1,867 5	114 0	57 2	171.2	2,101 8
20	88 4	42 6	131 0	1,998 5	110 0	65 6	175 6	2,277 4
21	98 8	47 5	146 3	2,144 8	94 8	72.7	167 5	2,444 9
22	99.2	42 9	142 1	2,286 9	146 4	59 6	206 0	2,650 9
23	105 4	49 9	155 3	2,442 2	127 0	53.2	180 2	2,931 1
24	103 4	43 5	146 9	2,589 1	118 1	44 7	162 8	2,993 9
25	115 0	49 0	164 0	2,753 1	147 9	37 2	185 1	3,179 0
26	91 8	37 4	129 2	2,882 3	108 5	42.1	150 6	3,329 6
27					116 0	27 9	143 9	3,473 5
28					117 8	56 5	174 3	3 647 8
29					165 9	57 6	223 5	3,871.3
30					143 9	61 5	205 4	4,076 7
31					179 8	31 9	211 7	4,288 4
32					247 3	45 5	292 8	4,581.2
Total	1,468 4	1,413 9	2,882 3		2,723 0	1,858 2	4,581 2	

(Cornell University Extension Bulletin 240)

Grains and grain products These have been divided into two classes on the basis of available energy value in order to indicate an approximate "ceiling' on the use of medium and low energy products As a general practice, selection among lower energy products should favor the better sources of energy in this group whenever possible The productive energy values as worked out by G S Fraps can be used as a guide for choosing grain products on a cost per-calorie basis (See Cornell Feed

Service, November, 1948, or Texas Agricultural Experiment Station Bulletin 678.)

The physical nature of the ground grains in poultry mashes also is an important factor to consider. In general, a high proportion of finely ground material should be avoided. In the case of wheat, it is particularly advisable to use a coarsely ground or crushed product; finely ground wheat is likely to form a sticky paste when moistened, and will lead to impaction of feed in the beak when used at a high level in the mash.

Vegetable proteins. Soybean meal can be used as the only vegetable protein supplement or in combination with corn gluten meal or peanut meal. Corn gluten meal or peanut meal should not make up more than one fourth of the total of this group of feedstuffs. Cottonseed meal can make up as much as one fourth of this group in chick rations when used in combination with soybean meal. Linseed meal cannot be recommended because of its growth retarding effect.

Animal proteins. These products serve as sources of protein, minerals, vitamin B_{12}, and at least one other still unidentified nutrient. The minimum levels recommended for starter and confinement grower mashes are the amounts needed to aid in supplying the unknown nutrient(s). The lower recommended figure in Table 40 refers to the minimum level of fish products when used alone; the higher figure indicates the approximate level of meat scrap when used alone. A combination of products appears to be preferable. Depending on cost and availability, levels higher than the indicated minimum amounts can be used in all poultry mashes; the amounts of protein, calcium, phosphorus, and vitamin B_{12} contributed by the animal products will accordingly determine the amounts of these nutrients needed from other sources.

The recommended levels of vitamin B_{12} refer to the amounts supplied by fish products, meat scrap, and vitamin B_{12} supplements. It is desirable to know the B_{12} content of the particular fish and meat products used, and this may be determined by laboratory assay. When such values are not available, an approximation of the B_{12} content can be calculated by assigning values of 40 micrograms of B_{12} per pound of fish meal, 70 per pound of fish solubles, and 15 per pound of meat scrap.

Other B vitamin carriers. These ingredients are valuable sources of many of the known B-complex vitamins. The levels

TABLE 40 Recommended Formula Patterns for Mashes for Young Chickens

Ingredient	Starter (All-Mash)	Growers (With Grain)	
		Confinement	Pasture
	Lb/ton	*Lb/ton*	*Lb/ton*
High-energy grain products (corn, wheat red dog flour, milo, oatmeal	900+	700+	500+
Medium- and low-energy grain products (oats, barley, wheat flour middlings, standard middlings, bran)	0–400	0–600	0–800
Vegetable proteins (soybean meal, corn gluten meal, peanut meal)	300–400	350–450	400–500
Animal proteins, minimum levels (fish meal, fish solubles, meat scraps)	50–100	50–100	
Other B-vitamin carriers (dried milk products, dried yeast, dried distillers' solubles, fermentation solubles)	100	100	
Dehydrated alfalfa meal	50–100	100	
Additional riboflavin (if needed)[1]	+	+	
Additional vitamin B_{12} (if needed)[1]	+	+	
Additional vitamin A (if needed)[1]	+	+	
Vitamin D_3 (feeding oils or D activated animal sterols)	+	+	
Calcium and phosphorus supplements (steamed bone meal, dicalcium phosphate, defluorinated phosphate, limestone)	30–50	60–80	80–100
Salt	5	10	20
Manganese sulfate (65 per cent feeding grade)	0.4	0.5	0.5
Required composition			
Protein (per cent)	20	20	20
Calcium (per cent)	1–1.4	1.5–2[2]	1.5–2[2]
Phosphorus			
Total per cent	0.6	0.9	0.9
Available per cent[3]	0.4	0.7	0.7
Vitamin A (I.U./lb.)[4]	2000	4000	
Vitamin D (I.C.U./lb.)	135	270	
Riboflavin (mg/lb.)	1.6	1.3	
Vitamin B_{12} (μ/lb.)[5]	1.5–2	1.5–2	

[1] Refers to the use of riboflavin supplements, vitamin-B_{12} supplements, and vitamin-A sources of guaranteed vitamin content, or other vitamin-rich feedstuffs when the formula is otherwise deficient in any of these nutrients.

[2] Free-choice feeding of oystershell or other calcium supplement recommended since this level of calcium will not meet full requirements.

[3] Approximately 30 per cent of the phosphorus of vegetable products is nonphytin phosphorus and may be considered as part of the inorganic or available phosphorus.

[4] If corn constitutes half of scratch-grain mixture for growing chicks, the level of vitamin A in the mash can be reduced by 1000 I.U./lb.

[5] Refers to vitamin B_{12} supplied by fish products, meat scrap, and vitamin B_{12} supplements.

recommended are intended to aid in supplying the unknown nutrient(s) referred to previously Since it is likely that more than one unidentified nutrient may be involved, it is wise to use these carriers in combination with animal proteins

Dehydrated alfalfa meal This product is an important source of vitamin A activity, but it is desirable to limit its use because of its low available energy value It is therefore necessary to use a high quality meal in order to supply sufficient vitamin A activity at a low usage level If additional vitamin A is needed, it should be supplied in another form such as a vitamin feeding oil rather than by exceeding the alfalfa levels recommended

Calcium and phosphorus supplements The phosphorus requirements are shown in Table 40 as both total phosphorus and available phosphorus The available phosphorus content of a mash is the amount supplied by the animal products and the inorganic supplements (bone meal, defluorinated phosphate, etc) *plus* 30 per cent of the rest of the phosphorus of the mash Calculating available phosphorus gives a more accurate appraisal of the phosphorus value of a mash than does the total phosphorus content

The phosphorus sources listed in the pattern table are nearly equivalent in phosphorus availability In choosing a phosphorus supplement care should be taken to insure that the product is intended for poultry feeding and has a sufficiently low content of fluorine

Vitamin D The recommended vitamin D levels are shown in International Chick Units, based on the new vitamin D_3 standard now in official use Feeding oils and D activated animal sterols are equally effective sources of vitamin D, unit for unit

Other riboflavin and vitamin B_{12} sources Riboflavin supplements and vitamin B_{12} supplements of guaranteed vitamin content are generally available and can be highly useful in meeting the requirements for these vitamins The levels of other vitamin rich feedstuff in the formula, particularly when amounts greater than the minimum levels are supplied, will determine whether and in what amount special vitamin supplements should be used

USDA photograph by Forsythe

Pedigreed pullets on a Missouri farm receive all through the summer the things they need to develop into heavy producers in the fall—plenty of feed and water and a clean, shady range

Feeding recommendations *Starter* To be fed as an all mash ration to chicks until six weeks of age Limited amounts of grain, not to exceed 20 per cent of daily feed intake, may be fed with it in the following two weeks

Confinement grower To be fed to growing chicks from eight weeks to maturity in confinement or on poor pasture This ration is designed for feeding free choice with grain

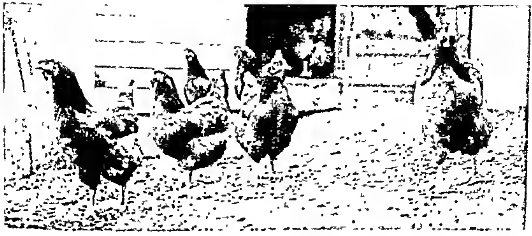
Pasture grower To be used with free choice grain feeding *only on good pasture supplying abundant succulent forage*

Grain mixtures The grain mixture can be composed as follows

Yellow corn	50%
Wheat	50%

Other common grains can be substituted for these when conditions are favorable

Feeding practice The chicks should be fed when they are 36 to 48 hours old Water or milk should be supplied as soon as the chicks are placed in the brooder The mash is fed in hoppers at all times The grain is also fed preferably in hop-



Pullets well started on a laying year.

pers but may be given on the ground or in litter. Grain feeding can be started at any time after the chicks are four weeks old. They should not eat as much scratch grain as mash by weight until they are three months old. Occasionally it may be necessary to restrict the grain in order to get proper mash consumption.

Special considerations. The ration or feeding management must sometimes be changed or given special attention because of the conditions under which the birds are kept.

Confinement and battery rearing versus range rearing. Most poultrymen prefer to rear the chicks on a good grass range. Clover ranges are much desired. Besides saving feed the average person can raise better birds on range.

When chicks are entirely confined, it is especially necessary that the ration be complete, since the feed mixtures cannot be supplemented with sunshine, green plant material, or other protective or nutritious substances found on range. If the chicks are reared on a good green range, the poultryman may get satisfactory results with a ration containing less protein and a smaller amount of milk than one which is fed to chicks in confinement. After the birds are two months of age, the dried milk can be replaced by other protein concentrates if the birds are reared on a good green range.

Feeding growing pullets. The pullets must not suffer any setbacks during the growing period. Some of the things to be given special attention are the green-food supply, water, and

TABLE 41 CORNELL STARTING AND GROWING MASHES

Ingredient	Chick Starter Mashes (All Mash)				Confinement Grower Mashes (Fed with Grain)				Pasture Grower Mashes (Fed with Grain)			
	Lb/ton	Lb/ton	Lb/ton	Lb/ton	Lb/ton	Lb/ton	Lb/ton	Lb/ton	Lb/ton	Lb/ton	Lb/ton	Lb/ton
Yellow corn meal	925	940	895	870	760	600	670	640	765	715	715	980
Ground wheat		200				200					200	
Wheat flour middlings	200			200	300			300	400	200		
Wheat standard middlings			200			300	200			200	200	200
Ground barley			100	200			100	300		100	200	100
Ground oats	200	200	100		200	200	200		200	100		100
Soybean meal	375	360	300	325	350	300	320	275	500	400	400	400
Corn gluten meal			100				100			100		
Peanut meal				100				100			100	
Fish meal	50	100			50	100						50
Fish solubles			50				50					
Meat scrap	50		50	100	50		50	100				50
Corn dried distillers' solubles	50		100		100		50			50		
Dried whey	50	50		100		50	50	100			50	
Dried brewers yeast		50				50						
Dehydrated alfalfa meal	50	50	50	50	100	100	100	100				
Riboflavin supplement to supply (mg riboflavin)	500 mg		700 mg									
Vitamin B_{12} supplement to supply (mg B_{12})	1 mg			2.5 mg	1 mg			2 mg				
D-activated animal sterols (1500 I.C.U./gm)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8				
or												
Vitamin feeding oil (300 D, 1500 A)	4	4	4	4	4	4	4	4				
Steamed bone meal	15	15	25	10	60	60	70	55	85	85	85	60
Limestone	30	30	30	30	20	30	30	20	30	30	30	40
Salt (iodized)	5	5	5	5	10	10	10	10	20	20	20	20
Manganese sulfate (65 per cent feeding grade)	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

TABLE 42 GEORGIA STARTING AND GROWING MASHES

BABY CHICK STARTING MASH FORMULAS

Ingredient	Ration 1	Ration 2	Ration 3	Ration 4	Ration 5
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Ground yellow corn	42	42	22	32	
Ground wheat	20			10	22
Ground oats	10	30	20		10
Ground barley				30	10
Ground kafir or hegari			30		30
Meat scrap	16	16	16	16	16
Milk products	5	5	5	5	5
Alfalfa leaf meal (dehydrated)	5	5	5	5	5
Salt	1	1	1	1	1
Cod liver oil (concentrated)	½	½	½	½	½

STARTING AND GROWING MASH

Ingredient	Pounds
Yellow corn meal	40
Wheat middlings or shorts	10
Wheat bran	15
Oatmeal or ground oats	10
Dried skim milk or dried buttermilk	5
Meat scrap	6
Fish meal	6
Alfalfa leaf meal	5
Table salt	1
Cod liver oil	½

SIMPLIFIED STARTING AND GROWING MASH FOR FARM USE (TO BE FED WITH LIQUID SKIM MILK OR BUTTERMILK)

Ingredient	Pounds
Ground yellow corn	50
Ground wheat	20
Ground oats or barley	20
Meat scrap	10
Table salt	1

(Department of Poultry Husbandry, University of Georgia, Athens, Georgia, 1941.)

amounts of grain consumed. They must have an adequate and complete ration at all times.

Feeding cockerels. Those males which are to be kept for future breeders should be given the same care and attention as the pullets. Similar opportunities for range and outdoor conditions and the same feeds and methods should be used as for the pullets.

Feeding broilers. In the feeding of broilers advantage

TABLE 43 Indiana Starting and Growing Rations

ALL MASH CHICK STARTING RATIONS—1 TO 10 WEEKS

Ingredient	Ration 1	Ration 2	Ration 6	Ration 7	Ration 8
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Ground yellow corn	400	300	500	300	400
Wheat bran [1]	100	100	100		100
Wheat middlings [1]	100	100	100		100
Ground wheat				300	100
Meat scraps (50 per cent protein)	90	100	50	70	70
Dried skim milk or buttermilk	30	35	40		
Soybean-oil meal (40 per cent protein)			200		
Alfalfa leaf meal	20	20	30	20	20
Bone meal			10		
Drink	water	water	water	milk	milk

[1] In Rations 1 and 2 finely ground oats may replace bran and middlings.

Ration 1 is the standard starting ration for early hatched chicks. Ration 2, higher in protein, is for later hatched chicks. Ration 6 is suitable when soybean-oil meal is low in cost, ground soybeans are *unsatisfactory*. With Rations 7 and 8 keep liquid skim milk (sweet or sour) or buttermilk available at all times—no water should be given. Special instructions on feeding winter broilers indoors may be obtained upon request.

G[illegible]e chicks *access to direct sunshine when 10 to 12 days old* or add to each 100 pounds a pint of 85 D-unit fish oil, or the equivalent in some other source of vitamin D. Feed as all-mash—no scratch grain is to be given. When good pasturage is available alfalfa-leaf meal may be omitted.

Do not make additions or substitutions. Products which seemingly have similar food value may prove disappointing or harmful. These rations have been tested on chicks and proved satisfactory when other conditions were favorable.

GROWING RATIONS—10 TO 20 WEEKS

Ingredient	Ration 1	Ration 2	Ration 3
	Pounds	*Pounds*	*Pounds*
Grain.			
Whole yellow corn	350	350	350
Mash.			
Ground yellow corn	100		
Wheat bran	100		
Wheat middlings	100		
Ground oats		150	
Ground wheat		150	300
Meat scraps	50	50	50

Provide a range with good pasturage. If pasturage is poor or tough, add 20 pounds of alfalfa-leaf meal to the mash formula. Keep grain in one trough and mash in another. Keep water available. Liquid milk may be fed and meat scraps omitted. If "all-mash" is desired, grind the grain and mix with mash ingredients in the proportions given.

(Division of Poultry Husbandry, Purdue University, Lafayette, Indiana, 1941)

should be taken of the early rapid growth of chicks. All mash rations are generally used for broilers. This is continued as an all mash ration until the birds are marketed. (See Chapter 11)

Flushing ration. At times it might be desirable to flush the birds by feeding a very laxative ration. This treatment is sometimes used in the case of coccidiosis.

The milk treatment can be used for treatment of coccidiosis,

TABLE 44. Oklahoma Starting and Growing Mashes

Ingredient	Chick Starter and Broiler Mash Formulas					Chick Grower Mash Formulas				
	CS490	CS491	CS492	CS493	CS494	CS490	CS491	CS492	CS493	CS494
Ground yellow corn or kafir	24	24	24	22	29	28	28	28	27	33
Wheat shorts	20	20		20	20	20	20		20	20
Wheat bran	10	10		10	10	10	10		10	10
Ground whole wheat			25					25		
Pulverized oats or barley	10	10	15	10	10	10	10	15	10	10
Alfalfa leaf meal	10	10	10	10	10	10	10	10	10	10
Cottonseed meal		5	5	5			5	5	5	
Soybean meal	10	5	5	5	10	10	5	5	5	10
Meat and bone scrap	10	10	10	10	5	5	5	5	5	5
Dried buttermilk or skim milk	5	5	5			5	5	5		
Dried distillers' solubles				7					6	
Fish meal					5					5
Salt	1	1	1	1	1	1	1	1	1	1
Ground limestone or pulverized oystershell						1	1	1	1	1
Manganese stock solution	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Vitamin concentrate[1]										

[1] To supply vitamins A and D (when necessary) according to manufacturers' directions.

(R. H. Thayer and R. B. Thompson, *Feeding Chickens*, Oklahoma Circular C-133, May, 1949.)

although it should not be looked upon as a cure. If the trouble should appear, however, at the first indications of the outbreak use the so called milk flush or milk treatment. This consists of feeding a mash which contains a large percentage of dried milk. A commonly used mixture follows:

40 pounds of dried milk
30 pounds of cornmeal
20 pounds of ground oatmeal or ground heavy oats
20 pounds of wheat bran

This mash should be fed with little or no grain for a few days. Then the regular ration should be used for a few days and the treatment repeated if necessary. During the treatment strict sanitation must be practiced.

Fall management of pullets. Pullets should be well developed in body before they start to lay. They should be in good condition with a surplus of body fat when they commence to lay if they are to withstand the demands of heavy laying. This means that they must have an adequate and complete ration at all times. It is a mistake, however, to feed pullets wholly on grain as they approach maturity; this slows up complete development as well as the urge to lay. Mash should always be fed along with scratch grain, as the mash is more complete in protein, minerals, and vitamins than is the scratch grain. The combination of the two furnishes the birds a more complete

assortment of food elements at the time they are finishing their development There is a very definite impression in the minds of some poultrymen that the time at which the birds begin to lay can be decidedly regulated by the amount of protein, par ticularly animal protein which is furnished to the pullets the last month or six weeks and in some cases only two or three weeks before those birds come into production It is doubtful whether you can influence the age of sexual maturity of pullets unless you feed below the necessary amount of protein, in which case growth is delayed

TABLE 45 Washington Starting and Developing Mashes

CHICK STARTING MASH FORMULAS

Ingredient	Ration 1	Ration 2	Ration 3	Ration 4
	Pound	*Pounds*	*Pounds*	*Pounds*
Coarse ground wheat	20 4	15 6	17 3	18 2
Ground yellow corn	20	20	20	20
Finely ground barley	5	5	5	5
Finely ground heavy oats	10	10	10	10
Mill run	20	20	20	20
Fish meal (70 per cent protein)	4 1	1 8	1	4 1
Meat scrap (50 per cent protein)		2 5	7	
Soybean-oil meal	10	8 3	6 6	5
Cottonseed meal				5 1
Dehydrated alfalfa	5	5	5	5
Dried whey		2 5	5	2 5
Fermentation by products, (113 500 micrograms riboflavin per pound) [1]	0 5		0 1	0 3
Distillers dried solubles (7 000 micrograms riboflavin per pound) [1]		5		
Limestone flour or ground oyster shell	2 3	2 4	2	2 5
Bone meal or defluorinated phosphate [2]	1 7	0 9		1 3
Salt (iodized)	1	1	1	1
Vitamin D supplement	Note 1	Note 1	Note 1	Note 1
Manganese sulfate	Note 2	Note 2	Note 2	Note 2
Total	100 0	100 0	100 0	100 0

Note 1 Add the following amounts of vitamin D supplements

Vitamin D Potency in A O.A C Chick Units per Gram	Ounces of Vitamin D Supplement per 100 Pounds
400	2 4
2000	0 5

Note 2 Add manganese sulfate at the rate of 0 2 of an ounce per 100 pounds or 4 ounces per ton

[1] If different unitage of riboflavin concentrate or crystalline riboflavin is used, adjust poundage between ground wheat and riboflavin concentrate.

[2] The amounts listed are for bone meal if dicalcium phosphate is used, only 67 per cent as much is required but it will be necessary to increase the calcium from ground oystershell or limestone flour by approximately 28 per cent.

TABLE 45 WASHINGTON STARTING AND DEVELOPING MASHES—(*Cont.*)

DEVELOPING MASH FORMULAS

Ingredient	Ration 1	Ration 2	Ration 3	Ration 4
	Pounds	*Pounds*	*Pounds*	*Pounds*
Coarse ground wheat	13.6	11.1	12.3	12.1
Ground yellow corn	10	10	10	10
Ground oats	20	20	20	20
Ground barley	10	10	10	10
Mill run	20	20	20	20
Fish meal (70 per cent protein)	4	1.9	1.0	4
Meat scrap (50 per cent protein)		2.6	6.8	
Soybean-oil meal	9.6	8.9	6.3	4.9
Cottonseed meal				4.9
Dehydrated alfalfa	7.5	7.5	7.5	7.5
Dried whey		1.5	2.8	1.5
Fermentation by products (113,500 micrograms riboflavin per pound) [1]	0.2			0.1
Distillers' dried solubles, (7,000 micrograms riboflavin per pound) [1]		2		
Limestone flour or ground oyster shell	1.8	1.8	1.5	2
Bone meal or defluorinated phosphate [2]	2.3	1.7	0.8	2
Salt (iodized)	1	1	1	1
Vitamin D supplement	Note 1	Note 1	Note 1	Note 1
Manganese sulfate	Note 2	Note 2	Note 2	Note 2

Note 1 Vitamin-D supplement should be added as follows

A Pullets which are raised on range, in yards, or on a sun porch do not require any vitamin D supplement added to the ration during the mooths of June, July, and August If pullets are confined to the house, the same amounts of vitamin D supplements recommended for the chick starting mash should be added to the developing mash

B From September to May inclusive, the same amounts of vitamin D supplements should be added to the developing mash as are added to the chick starting mash regardless of whether the pullets are running outside or are being raised in confinement

Note 2 Add manganese sulfate at the rate of 0.4 of an ounce per 100 pounds or 8 ounces per ton

[1] If different unitage of riboflavin concentrate or crystalline riboflavin is used adjust poundage between ground wheat and riboflavin concentrate

[2] The amounts listed are for bone meal if dicalcium phosphate is used only 67 per cent as much is required but it will be necessary to increase the calcium from ground oystershell or limestone flour by approximately 28 per cent.

(Poultry Pointers No 14 [Revised], State College of Washington, Pullman, Washington, 1947)

If the age at which the birds come into production is to be influenced to any extent, it can be done only by reducing the protein two months or more before the birds begin to lay, in which case growth will be materially delayed This is a questionable practice It is not advisable to 'hold back' pullets in the fall Earliness of laying is an inherited factor controlled

TABLE 46 Washington Chick and Pullet Feeding Schedules

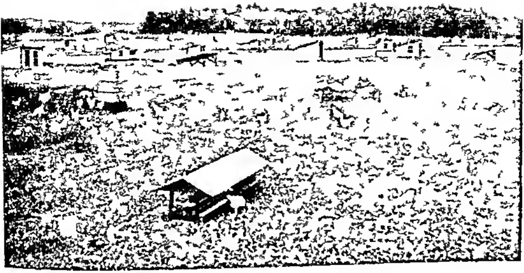
Chick Feeding Schedule (1 to 8 Weeks)

Chicks purchased from hatchery should be fed on arrival. Chicks hatched at home should not be fed until 24 hours old.

Age of Chicks	6 to 7 A.M.	Noon	5 to 6 P.M.
First Week	Give water in clean fountains. Have ½ inch drinking space per chick. Keep starting mash in hoppers—1 inch eating space per chick. Feed heavy-breed chicks half grain first two days.	Water Starting mash in hoppers. Fine cut (½ inch) tender green feed all that the chicks will clean up.	Water Fill mash hoppers. Feed chick-size hard grit or coarse sand in separate hoppers. See that chicks are made comfortable for the night.
Second Week	Keep fresh water in clean fountains. Fill mash hoppers. Get chicks out of doors if weather permits.	Renew clean water Fill mash hoppers. Keep cut green feed before chicks. ¼ pint chick-size grains per 100 chicks fed on mash or in litter	Fill mash hoppers. Make chicks comfortable before dark. Feed chick-size granite grit or coarse sand.
Third Week	Fill clean fountains with fresh water Fill mash hoppers—1½ inches eating space per chick. Keep cut green feed before chicks.	Renew clean water Fill mash hoppers. ½ pint chick-size grains per 100 chicks fed on mash or in litter Chicks out of doors.	Renew clean water Fill mash hoppers. Keep chicks from crowding at bedtime. Continue chick-size hard grit or coarse sand.
Fourth to Eighth Week	Keep cut green feed and water before chicks. Continue chick starting mash and keep in hoppers—two 4-foot hoppers to 150 chicks. Change to whole wheat and keep it in hoppers or feed all they will eat 3 times daily in the litter Continue coarse sand or granite grit in hoppers. Encourage chicks to roost at end of 4th week. All chicks should be roosting during 6th week. Remove all cockerels. Sprinkle whole oats on top of mash during the 4th week. Feed whole oats in hoppers.		

Pullet Feeding Schedule (9th Week to Maturity)

Ninth to Eleventh Week	Keep green feed and water constantly before pullets. Gradually change to developing mash and keep in hoppers. Continue feeding whole wheat either in hoppers or in the litter Change to equal number of mash and grain hoppers—one 6-foot mash hopper and one 6-foot grain hopper per 100 pullets if grain is hopper fed. Keep feeding heavy oats in separate hoppers. Feed medium size hard grit. Beginning the 11th week, keep shell or limestone grit in separate hoppers.
Twelfth Week to Maturity	Keep green feed and water constantly before pullets. Continue developing mash and keep it in hoppers. Continue feeding heavy whole oats in hoppers. By the end of the 12th week have one 6-foot mash hopper, one 6-foot scratch hopper and one 6-foot oat hopper per 100 pullets, if grain is hopper fed. Feed medium size hard grit. Keep shell or limestone grit in separate hoppers. Continue feeding whole wheat either in hoppers or in the litter



Pullets grown under good range conditions

primarily by breeding Time of laying can be influenced only a few weeks by feeding The best all round results are secured when the birds are so managed that they can be kept growing continually and come into production normally Therefore, the problem is to combine the breeding and feeding factors and not to expect that one can take the place of the other For example, birds that have been bred to lay at six months of age should be fed to produce sufficient body growth by the time they begin to lay This method is preferable to retarding their development in the hope of delaying sexual maturity

A short time before moving the birds to winter quarters, it is advisable to change from the growing to the laying mash and to feed some of the grain in the houses in a manner similar to that in which they will later be fed Both grain and mash should be hopper fed for several weeks after the birds are placed in winter quarters

RECOMMENDED RATIONS FOR FEEDING THE YOUNG STOCK

Many satisfactory rations for growing chickens have been used They will vary according to the feeds that are available

As typical examples, Tables 41 to 45 show representative rations that are fed in different sections of the United States

SUGGESTIONS AND QUESTIONS

1 Assemble feeding data from poultry flocks in your area and note the starting and growing rations which give the best results How do yours compare with them?

2 Compare the ready mixed starting and growing rations offered for sale in your locality with respect to price guaranteed analyses, ingredients and quality

3 Prepare a detailed calendar of work for taking care of the necessary operations involved in a baby chick brooding and feeding project with 300 baby chicks from the beginning until the cockerels are marketed at 2–3 pounds each

4 Visit successful poultry farms to observe rearing practices

5 If possible keep weight and feed records for a flock of chicks from day old to maturity Calculate such factors as average weights, rates of growth feed to produce a pound of gain for various ages and feed required per bird

6 Formulate a chick ration with feeds available in your market Compute the various nutrients to be sure the recommended allowances are met.

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CHAPTER 10

Feeding Hens for Production

THE SUCCESS of most poultrymen depends upon the number of eggs their hens produce. In order that the birds shall lay well they must be given favorable environment, especially during the seasons of unfavorable conditions. Poultrymen are not doing their duty by the birds unless they do all they can for them, and they cannot expect good production unless they give them a fair chance.

The ability to produce a large number of eggs depends upon several factors. In the first place, the birds must be bred for egg production. They must have strong constitutional vigor and must be hatched early enough to be able to mature properly before cold weather begins. They must have the inherited tendency to lay and must possess the physical requirements to do so. While one must not forget that hens have individuality, one can consider that in some respects they resemble machines and must be built according to a proper design. Capacity and ability to make efficient use of the raw materials (feed) are essential. The machines must also be protected from the weather. Clean, dry, light, well-ventilated, and reasonably warm quarters free from drafts or sudden changes in temperature need to be provided to house the birds comfortably; for comfort tends toward contentment and contentment encourages production. One then needs to care for and feed the birds correctly in order to maintain health.

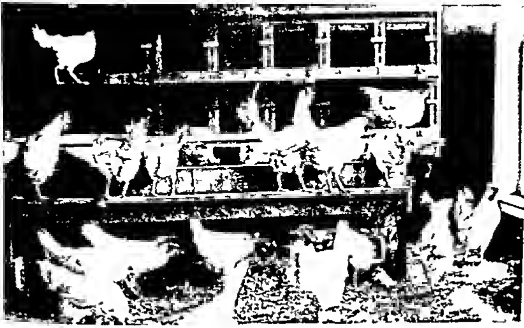
At the beginning there must be some understanding of the importance of feeding. When fowls are given all of their food, each hen will consume from 75 to 100 pounds of feed a year, depending upon her size and production. On the average,

Leghorns consume about 80 pounds, Rhode Island Reds, New Hampshires, Plymouth Rocks, and Wyandottes, 90 pounds, and the heavier varieties, 95 pounds The feed cost usually constitutes 50 per cent or more of the total cost of keeping the hens

THE NATURE OF THE HEN

In order to feed intelligently, one must be familiar with the hen, the feed, and the finished product, which, in this case, is the egg The hen is the machine that transforms the feed into the finished product In caring for her one must always bear in mind certain things (1) Fowls are fed as a flock rather than as individuals (2) Compared with other animals, cattle, for example, the hen has a higher body temperature and has greater activity, in fact, all the body processes are more rapid This is particularly true of breathing and digestion (3) Estimates have been made that a hen consumes in proportion to her weight twice as much dry matter as does a dairy cow On this basis W H Jordan, of the New York State Agricultural Experiment Station, states that the hen is probably the most efficient transformer of raw material into a finished product (4) The digestive system is short and comparatively simple It has only slight provision, if any for the digestion of fiber and does not have a very large capacity Consequently, coarse and bulky feeds are not fed to any great extent. On the other hand, the large use of concentrated feeds increases the danger of indigestion, so that there must be a proper balance of feeds

The function of the hen is to manufacture products useful to man Used in the process are grains and their by products, animal by products vegetable feeds, and minerals Many waste and by products not eaten by man are transformed into edible products Before any useful product can be turned out, however, the hen must maintain herself This means she must provide, first of all, heat, energy, and material for elaborating body secretions and replacing worn-out body tissues As a rule it requires from 75 to 80 per cent or more of the feed consumed to meet these maintenance needs The remainder of the feed can go toward growth—that is, the increase of body tissues—and reproduction In the case of the hen,



A flock of hens properly cared for will respond in egg production.

production is also reproduction, since every egg is complete and if fertilized should be capable of producing a chick.

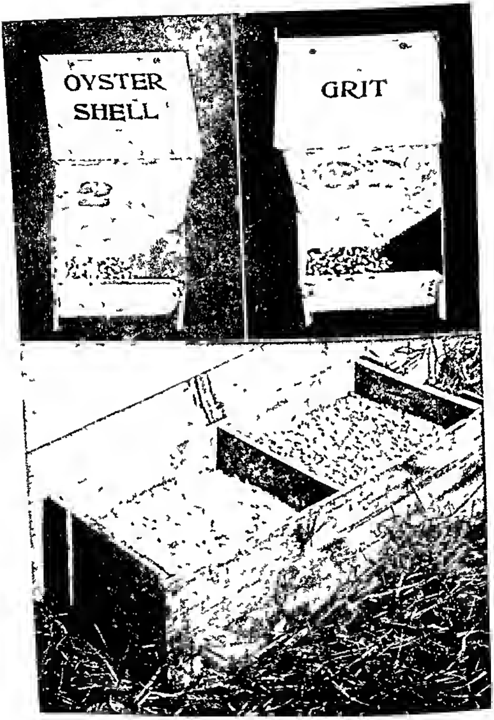
REQUIREMENTS OF THE RATION FOR EGG PRODUCTION

The same detailed standards of requirements as have been worked out for other animals are not yet available for poultry. A study of a number of successful rations for egg production, as well as the available experimental evidence, would indicate the probable requirements for protein, minerals, and vitamins to be as follows:

Protein. In order to promote satisfactory production, maintain body weight, and obtain good egg size, the ration should contain from 15 to 16 per cent of protein. Part of this should come from animal sources.

Minerals. Calcium and phosphorus are the two minerals needed in largest amounts. The ration should contain from 0.7 to 0.9 per cent of phosphorus and from 1.8 to 2.2 per cent of calcium.

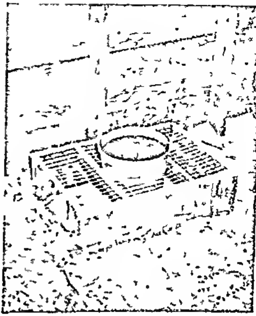
Manganese is necessary for strong egg shells. The requirement seems to be about 40 to 50 parts per million. Many



Either wall hoppers or low boxes may be used to supply shell and grit.

commercial feeds include one-quarter pound per ton of manganese sulfate to insure enough of this mineral.

In order to supply a possible deficiency of sodium and chlorine, the common recommendation is to add ½ per cent of salt to the ration.



Water stand with drinking pail. The wire stand prevents the water from falling on the litter and causing dampness.

Vitamins. A ration containing a minimum of 200 International Units of vitamin A per pound will give normal results. Larger amounts may be desirable. A ration containing 35 per cent of yellow corn and 2½ per cent of alfalfa will supply this amount.

If the birds do not get the benefit of direct sunshine, it will be necessary to supply vitamin D in the ration. A minimum of 230 International Chick Units of vitamin D per pound of feed is essential.

The amounts of other vitamins which are needed are not well known. They do not need to be given special consideration because the amounts required for egg production are small or the rations composed of normal ingredients usually contain enough to supply the hen's needs.

Fiber. Not much is known concerning the fiber content of the ration. It is known, however, that very little fiber, if any, is digested by poultry. Hence, the amount should be restricted. Furthermore, fibrous feeds are less palatable than others and thus have an influence upon food consumption. The ration should probably not exceed 5 per cent of fiber.

Water. One dozen eggs contain about 1 pint of water. Therefore, the hens must have a sufficient supply of clean, fresh, pure water, which should be kept constantly before them. If running water is not available, the supply should be renewed at least once daily. During cold or freezing weather warming the water is advisable.

Grit. The hen requires some medium to help grind her food The grinding process takes place in the gizzard Grit is particularly essential for those birds which consume materials that need to be ground, such as coarse grain, grass, feathers, and litter Crushed oystershell has some grinding value However, grit may also be supplied especially for this purpose

ABSENCE OF FACTORS HAVING UNFAVORABLE PHYSIOLOGICAL EFFECTS

There should be nothing present in the ration to cause the hen to function abnormally, since the best results can only be obtained when the individual approaches normality It is entirely possible to meet all the conditions already stipulated and yet have their favorable influence overcome by the presence of a toxic or poisonous substance Injury wrought by microorganisms in the alimentary tract of the hen would not enable the hen to make the best use of the feed In fact, any condition of disease would to a greater or less degree cause pathological functioning Such undesirable physiological effects as constipation or looseness of the bowels may be caused by the inclusion of too much of certain ingredients in the ration Some feeds as oil meal dried whey, and wheat bran, are laxative, others, as cottonseed feed, are constipating

Thus it is seen that there must be a balance between all the parts of a ration and that certain conditions must be met or the ration will not be complete Unless it is complete, production will not be satisfactory The results obtained will probably be proportional to the completeness with which the requirements are met

RECOMMENDED NUTRIENT ALLOWANCES

The Animal Nutrition Committee of the National Research Council has issued recommended allowances for poultry rations These differ from requirements, which refer to actual amounts needed at the time of consumption, in that margins of safety are provided to take care of variation in the nutrient content of feedstuffs, variation in feed requirements, and vitamin destruction during reasonable periods of storage

The recommended nutrient allowances for hens are given in Table 47.

Many feeding methods or systems are met with in the feeding of poultry These range from the so-called mashless or all grain rations to the grainless or all mash rations, with the com bination or grain–mash rations ranging between these two extremes Also, various modifications or combinations of these systems are used Each system has its advantages and disadvantages The combination ration or feeding of both grain and mash is used more extensively than others, however

Factors which might influence the choice of a method are labor considerations, cost of feed, and actual results in egg production

TABLE 47 NATIONAL RESEARCH COUNCIL RECOMMENDED NUTRIENT ALLOWANCES FOR HENS (AMOUNT PER POUND OF FEED)

NUTRIENT	LAYING HENS	BREEDING HENS
Total protein (per cent)	15	15
Vitamins		
Vitamin A activity (I U)[1]	3300	3300
Vitamin D (I C [2] Units)	340	340
Riboflavin (mg)	0 9	1 3
Pantothenic acid (mg)	2 5	5 0
Pyridoxine (mg)	1 6	1 6
Biotin (mg)	?	0 07
Minerals		
Calcium (per cent)	2 25[3]	2 25[3]
Phosphorus (per cent)[4]	0 75	0 75
Salt (per cent)[5]	0 50	0 50
Manganese (mg)	?	15 00
Iodine (mg)	0 30	0 50

[1] May be fish-oil vitamin A or pro vitamin A from vegetable source.
[2] International Chick
[3] This amount of calcium need not be incorporated in the mixed feed inasmuch as calcium supplements fed free choice are considered as part of the ration.
[4] Inorganic phosphorus should constitute 0 4 per cent of the total feed.
[5] This figure represents added salt or sodium chloride.

The amount of labor required and the development of routine depends to some extent upon the method of feeding Labor represents the second largest item in the cost of producing eggs On many poultry farms the feeding must be left to hired help Hence, the ability of this help is a factor The method of feeding decided upon may depend upon the amount of respon sibility that can be turned over to the hired help Some feeders do not observe the hens closely and thus do not regulate the amounts or proportions of feed to the needs of the hens Under

such circumstances, the hens frequently are able by free-choice feeding to better govern their needs than is the feeder

The amount and cost of feed consumed is relatively not so important because, in general, food consumption is closely correlated with egg production Slightly higher food intake may occur with the feeding of larger proportions of grain, but as grain is usually cheaper the net cost per bird may not be changed

The result in egg production is the final measure of any feeding system Egg producton varies because of differences in inheritance and environment. Methods of feeding may show slight variations in results, but these frequently are not significant, especially if a slight gain in production is offset by increased labor or feed cost

Since no one method of feeding can be said to be best under the many conditions that exist, it appears that a first essential is a good mash which should be before the birds at all times Hens should be given some leeway in consuming proportions of grain and mash to meet individual requirements Most methods, where grain and mash are fed supply this requirement

Mashless rations This method is sometimes called the whole-grain method With it no ground feeds or mashes are used The ration is not restricted to grain alone, however, but the grain is usually supplemented with an animal protein feed such as milk or meat It is also desirable to have the birds on grass range or to feed some green food equivalent. This method is sometimes used where home-grown grains are fed and where milk is also available A regular daily supply of skim milk or buttermilk must be obtained and sufficient drinking space furnished

All mash rations With all mash rations no whole or cracked grain is used The feed is given entirely in the ground form or as a mash This method of feeding has the feature of simplicity, since only one feed is used Less skill is required in feeding This is an advantage to the unskilled feeder as there is no doubt or confusion about what proportion of scratch grain to feed There is a more uniform intake of food on the part of the hen which will tend toward uniformity of production and yolk color

Courtesy Future Farmers of America

Homemade equipment is featured in this California laying house. The Future Farmers pictured feeding their birds learn poultry management through classroom study and practical experience. Equipment was constructed by the students in the vocational agriculture department's farm shop.

The chief disadvantage seems to be to get sufficient food intake at all times. For that reason, it is necessary to observe the birds and to supplement the all-mash with wet mash, pellets, milk, or other palatable feeds when necessary. This method requires observation and some skill. Also, the ground grains are slightly more expensive than the whole grains.

In the main, experimental results favor the feeding of both grain and mash to hens for egg production, although satisfactory results have been reported with all mash rations, particularly where due regard was given to food intake.

Grain–mash rations. This method of feeding makes use of a grain mixture and a ground feed or mash mixture. It is also called the combination or scratch mash method.

The generally good results account for its extended use. By grinding part of the feed, some saving is made on food as compared with feeding all whole grain. A mash mixture en-

ables the use of valuable by products, such as those obtained from the milling and packing industries It is easy to include animal protein feeds and to balance the ration by the addition of mineral and vitamin carriers

The chief disadvantage seems to be the difficulty of knowing the proportions of grain and mash which a hen consumes The ration is easily put out of balance by a variation in the propor tion of grain to mash consumed The natural tendency for hens to eat grain might cause a protein, vitamin, or mineral deficiency For that reason one must know what proportions are needed for any particular ration and to regulate the grain and mash intake accordingly

The usual practice with the grain–mash system of feeding is to keep the mash constantly in hoppers so that the birds have free choice of mash at all times The feeding of grain, however, has a number of variations It might be fed in the litter at night in amounts that the birds will eat before going to roost Little or no grain is then fed in the morning The grain might be fed in troughs at night with no grain in the morning, or it might be kept constantly before the birds Where the birds have free choice of grain heavier grain consumption usually results and hence it may be more necessary to restrict the grain at times in order to regulate the proportion of grain to mash according to the mixtures used Continued heavy grain con sumption may necessitate the use of a mash which contains larger amounts of fish oil and other vitamin and protein carriers than are present in the average mash

Mash concentrates In the past few years mash concentrates have been used quite extensively They are intended par ticularly for those farmers who wish to buy a commercial con centrate or for those who want a formula which can be prepared in quantities for them by their local feed dealer to combine with the home-grown grains which are available at the time The proportion of home grown grains which may be combined with a concentrate may be varied considerably without disturb ing egg production Because of the fact that the grains are low protein feeds and are deficient in many of the other essential nutritive substances a poultry mash concentrate must contain more protein than an ordinary mash and also more vitamin A and vitamin D

With any of these methods, a supplementary feeding of wet mash, milk, or pellets might be necessary at times in order to increase food intake This is usually done on cold days and during the summer and fall

The system of feeding in itself is not the important factor The important thing seems to be whether the birds consume as much feed under one condition as another and whether under that method of feeding they are getting a proper balance of nutrients in their feeds Hence, a balance of the ration combined with palatability is required so as to get sufficient feed consumption Wide variations in feeding methods are possible as long as they do not make it impossible for the hens to get sufficient daily food consumption or as long as they do not interfere with the building and consumption of a ration complete in all essential nutritive factors With these limitations taken care of, there does not seem to be any single method of feeding which, under all conditions, can be called the best

FEEDING PRACTICES

How grain should be fed. The grain may be fed by hand in a litter or it may be fed in troughs The amount of grain to be fed depends upon the composition of the mash used with it The recommendations given with the ration should be followed at all times If the ration calls for the consumption of equal parts of grain and mash, the grain should be so fed as to regulate the amount of mash eaten The birds will usually eat the grain when given a choice If the amount of grain is restricted, the fowls can be induced to consume more mash Feeding should be done according to the condition and production of the birds No definite rule can be given that would apply to all conditions of season and production

When feeding grain in the litter it should be fed scantily in the morning, from about 1½ to 2 quarts to 100 hens No grain should be in the litter at noon, when so found, it indicates that too much grain had been fed in the morning All the grain that the hens will eat should be given in the late afternoon in time for them to find it before dark, so that the birds will go to roost with a full crop All of the grain should be fed in a dry, clean, straw litter, from 4 to 6 inches deep Exercise is as necessary for chickens as it is for other animals, it

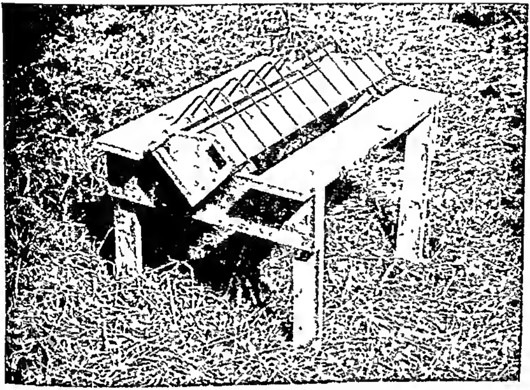
helps to keep them healthy and in good condition, promotes digestion, strengthens their muscles, makes them eat more, and produces heat which is essential for production.

Trough or hopper feeding of grain as well as mash is gaining in favor because of sanitary reasons. With this method better control of grain consumption is possible, and the hens are assured all they want to eat before going to roost. When feeding grain in troughs, the birds should have it available early enough in the afternoon so that they can eat what they want before roosting time. About four o'clock is the usual time for opening the grain hoppers. With this method no grain is fed in the morning. The time of opening the hoppers should be adjusted to regulate the proportion of grain to mash. The hopper should be opened earlier when more grain needs to be consumed.

With continuous hopper feeding of grain, the feeders are kept supplied with grain at all times. Sometimes the grains are fed separately. This is particularly true where oats are fed. The proportion of the different grains is sometimes varied depending upon the preference shown by the birds.

Litter. The common straws in the order of their desirability are wheat, oats, rye, and buckwheat. If straw is not available, shredded or cut cornstalks, shavings, or leaves may be used, especially where trough feeding is practiced. Peat moss, hulls of oats and other seeds, peanut shells, and many other materials are also used for litter. The litter should be strictly clean, and free from mustiness, mold, or decay, as serious losses frequently occur from these sources because of spores which may develop into fungous molds in the lungs or intestines of the fowls. If the grain is fed in the litter, it should be deep enough so that the grain is hard to find and yet not so deep that fine grain is lost. If there is only a small amount of litter on the floor, the hens will soon scratch it over and pick out all of the grain. When the hens have gone over the litter a few times and find no more grain, they will be inactive until the next feeding. The litter should be dry enough so that the grain will readily settle in. When new litter is provided it should be at least 6 inches deep. This will make the birds hunt for some time before they find all of the grain.

How mash should be fed. Under most conditions the mash should be fed dry in hoppers, troughs, or boxes. If open boxes



One type of mash trough. With this feeder a close record of the daily consumption of mash can be kept. The hens are given a good chance to eat, but the trough is so made that the wasting of feed by the birds is prevented.

are used, they should be raised from the floor. To prevent waste where a reel or wires are not used, a piece of 1-inch-mesh poultry netting should be placed on top of the mash. The use of the dry-mash system of feeding has its advantages in requiring less labor, in making larger flocks possible by giving all the hens an equal chance, and in requiring less skill in feeding. On the other hand, the dry mash is not so palatable as the wet mash.

The wet mash also has its advantages. The feed is swelled and softened, there is less sorting of the mash and hence less wasting, and it is possible and easy to use waste meats and table scraps in the wet mash. More labor and skill are required. However, the wet mash may be used to advantage to supplement the dry mash in order to increase food consumption. It may be used to help in keeping up the production of hens at such times when they are not eating enough feed. The regular dry mash should be mixed with enough skim milk or but-

Frequent feeding of mash encourages feed consumption

termilk to make it crumbly This should be fed in the afternoon, before the night feeding of grain, in amounts that the birds will eat in about a half hour Another practice is to pour milk over the dry mash

Amount of feed. The amounts of grain and mash must be regulated according to the recommendations given with the ration If the mash contains a large amount of meat scrap or other protein concentrates, larger proportions of grain should be fed, so that the ration as a whole does not contain more protein than is needed for economical production In order to maintain the correct proportions of grain and mash in daily practice it is well to keep a record of the feed and eggs This may be easily done by means of a simple record sheet showing the amount of feed supplied to the different flocks Covered cans barrels boxes, or hoppers should be kept in each pen and filled as needed A sheet of paper and a pencil attached to a cord may be tacked on the wall near the feed containers

The birds can be induced to consume more mash by restricting the grain feeding especially the morning feed, or, if the hoppers are being left open only a part of the day, by increasing the length of time during which the mash is available, or by wet mash feeding When grain is given liberally in the morning the mash consumption decreases

The relation between grain and mash must be maintained in order to keep the balance of the ration By increasing the grain feed, one tends to build up the bodies of the birds, by increasing the mash part of the ration, one tends to stimulate production This is true because the mash contains more protein and large amounts of the other essential nutrients In

creasing the amount of grain will help toward increasing the total feed eaten With the greater amount of grain fed, one must be careful not to decrease the mash consumption At this point the use of milk, which then takes the place of mash be cause of its animal protein nature and its dry matter content, or the wet mash, will help to maintain the balance

It must always be kept in mind that the food consumption will increase when production increases and that the hens should at all times get in the proper way all the feed that they will eat, that is, in such a manner that they will keep busy dur ing the day and that they may go to roost with full crops so that digestion and assimilation may continue during as much of the night as is possible or necessary

FOOD CONSUMPTION

Amount per bird. The amount of feed necessary depends upon the size of the hens, the season of the year, and the rate of production More feed is needed for larger birds and for heavy production than for smaller birds and low production Colder weather also requires more food to keep up body temperature

In addition to proper consumption of grain and mash, a sufficient daily intake of feed is necessary Birds averaging 4 pounds in weight require about 19 pounds of total feed per 100 birds daily for maintenance Also, they need approximately 1 pound more of feed a day for 100 birds for each 10 per cent increase in egg production

The following amounts are given as the probable quantities of food necessary for average Leghorns (weighing 4 pounds)

Per Cent Production	*Lbs of Grain and Mash per Day for 100 Birds*
20	21
30	22
40	23
50	24
60	25
70	26
80	27

For heavier birds such as the American breeds the amount should be increased 2 to 3 pounds or approximately 2 pounds

Hens busy at the feeding hopper means production

for each 1 pound increase in weight It is essential to get the birds to consume enough feed daily Food intake must be above a certain minimum level It is not always easy to get the birds to consume enough feed

Decreased total food intake may be due to a decrease in the mash or the grain or both When food consumption decreases steps must be taken immediately to increase the same There are various means of accomplishing this and in most cases the means need be only temporary until the birds respond

Several measures of stimulating feed consumption have proven satisfactory Wet mash feeding is the most common Other measures are (1) liquid milk to drink (2) supplementing the ration with any palatable food such as condensed milk green-cut bone and fresh meat or blood (3) changing the grain ration if the birds show preference for certain grains and (4) feeding more frequently and increasing the length of the day The feeding of pellets as a supplementary food has also

been reported as giving favorable results and can be fed in the place of wet mash.

Representative average food consumption per year might be indicated as follows:

	Range	Average
Leghorns.	75–85 lbs.	80 lbs.
American breeds	85–95 lbs	90 lbs.
Asiatic breeds	90–100 lbs.	95 lbs.

More feed is required with higher egg production, for younger birds, during colder seasons and when the birds do not have the opportunity to supplement their feed from range. There is some variation in monthly feed consumption, chiefly because of the fluctuation in egg production.

Pounds of feed to produce one dozen eggs. The economy of producing eggs can be measured by the pounds of feed necessary to produce one dozen eggs. The efficiency of production is closely associated with the average number of eggs produced. With good egg production it will take about 4 to 6 pounds of feed to produce one dozen eggs.

MODIFICATION FOR SPECIAL CONDITIONS

For the best results, it is necessary to segregate the birds into as many units as there are different conditions of birds in the flock and to manage them accordingly. This does not necessarily mean that different feeds must be used for each group. More often the variation will come in the manner of feeding the same ration and in the management of the flock.

Feeding pullets. In order to encourage liberal grain consumption, the grain should be kept in hoppers before the pullets all the time for the first month or six weeks of production. After that time the grain may be fed only in the morning and afternoon. The birds should be allowed all the grain they want at night.

In order to maintain health and production, a combination of factors must be right. If one or more of these requirements are not met, the flock drops in production. Too often this is overlooked in feeding pullets, since the onset of sexual maturity with its urge to lay will carry them in production for a month or six weeks even on a deficient ration. The pullets

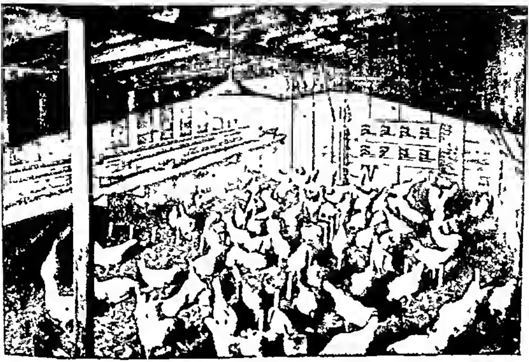
should not only maintain their weight and flesh but should actually be completing their growth during the first few months of production To produce eggs at the expense of their body weight or to lay themselves out" is positively detrimental

With pullets which, because of early hatching or rapid development, have come into production early (August or September), there will be a tendency toward decreased production because of the shortening days late in September and October and the cold weather At this time a decided slump in production, followed by a molt and a period of unproductivity, often occurs This class of birds needs careful observation It is of prime importance to maintain the weights of the individuals Whenever the birds are losing weight or production begins to decrease, there usually occurs also a decreased feed consumption of one part of the ration or of the feed as a whole Introduction of milk, wet mashes, or artificial illumination of the poultry house at the proper time will help to overcome this difficulty he lights should usually be turned on by September 1

Late summer and fall feeding of hens Production during the late summer and fall is accomplished under conditions which normally are not favorable In order to hold production, the mash consumption must be increased This usually calls for wet mashes and milk during the late summer and fall Artificial illumination of the poultry house also gives the birds a better chance The lights should usually be turned on not later than August 15

Feeding during the molt. When the birds stop laying and begin to molt, the amount of grain fed should be increased to increase the weight and the amount of body fat Hopper feeding of grain is advisable The feeding of milk and green food at this time should be emphasized Hens that have stopped laying during August and early September can be brought back into production, so as to be put under lights by October 15 to November 1, by placing them on a clover or alfalfa range, hopper feeding grain and mash and giving them milk to drink. They will then respond well for winter production

Care of broody hens Broody hens should be removed from the nest as soon as noticed, and confined in a light, well ventilated coop with a slatted or wire bottom They should be fed regular laying mash (preferably moist) and should not be fed



A well-lighted floor makes it possible for the birds to use the entire floor area. Lighting units should be 6 feet from the floor and 10 feet apart.

grain. They should have water to drink. Milk may be fed as a supplement.

Breeds. The same ration can be used for the various breeds of poultry. The method of feeding may need to be varied. For the heavier varieties of birds, grain may need to be fed rather scantily in the morning to encourage exercise, and a slightly larger amount of mash may be fed.

ADAPTING THE RATION TO ARTIFICIAL ILLUMINATION

When artificial illumination is used in the poultry house, the grain and mash mixtures remain unchanged, but the method of feeding must be adapted to the method of illumination. Though the underlying principles are the same, the time of feeding must be arranged to fit the working hours of the birds. In order that activity may be encouraged, grain should be fed lightly at the beginning of the hen's day. If morning illumination is used, the grain may be scattered in the litter the night before. The dry mash and water should be available during the entire time that the birds are off the roost. Grain should

be fed heavily at the end of the day (with either natural or artificial lighting), about one hour before the birds go to roost Green food should be supplied in the middle of the birds working day

Watch the flesh condition of the birds, since they may have a tendency to produce eggs at the expense of their bodies, and give special attention to their weight which is one of the best measures of condition If they begin to lose flesh, increase the amount of grain fed and supplement it with a wet mash

FEEDING BREEDERS

The requirements for the breeders are the same as for layers except that they require larger amounts of some of the vitamins (See Table 47, Recommended Nutrient Allowances for Hens) This is particularly true of riboflavin, biotin, pantothenic acid and some of the unidentified vitamins The greater riboflavin requirement is usually supplied by increasing the amount of milk or other riboflavin concentrates

The breeders should be those birds that continue to lay the latest Fall production can be stimulated by the use of wet mashes milk, and artificial illumination of the poultry house The lights should usually be turned on not later than August 15 It probably is not advisable however, to continue the lights later than a date after which the birds can get well along into their molt by the time severe cold weather sets in For central New York this stimulation for production should probably cease about November 1 to 15

When the birds stop laying and begin to molt, the amount of grain should be increased It may be hopper fed at this time Green food and milk or their equivalent should be furnished in abundance

Production should not be encouraged until about one month before eggs are to be saved for hatching A small amount of artificial illumination (not to exceed 12 hours) may be used to advantage during the winter, and this may be increased just before the hatching season

Heavy grain feeding is usually practiced during the winter in order not to encourage too-heavy production previous to the hatching season If possible the breeders should be given

access to the ground and to direct sunshine (not through glass) at all times

After the season for saving hatching eggs is over, the breeding hens can be given the same feeds and management as the laying hens for the balance of the year

TYPICAL RATIONS FOR PRODUCTION

A proper ration usually includes grain, mash range or green food, sunshine or some form of vitamin D, oystershell, and water

Grain mixtures Corn and wheat are the grains used in largest amounts Barley and heavy oats or buckwheat are sometimes used A scratch mixture of equal parts of corn and wheat can be used as a basic mixture Varying amounts of the other grains may then be substituted for some of the corn and wheat

Mash mixtures The formulas of mash mixtures may differ considerably, depending upon the feeds available and whether they are to be fed alone or in combination with grain When fed with grain, the proportions of grain and mash to be fed affect the mash formula About equally favorable results can be obtained from the different rations so long as the essential nutrients are properly provided

The combination or grain-mash rations are used more extensively than other systems Many such rations are formulated so that approximately equal parts of grain and mash are fed

The recommended formula patterns for poultry mashes for layers and breeders are given in Table 48

Grains and grain products Cereal grains and their by products are used primarily as sources of energy in poultry feeding These have been divided into two classes on the basis of available energy value in order to indicate an approximate ceiling' on the use of medium and low energy products As a general practice, selection among lower energy products should favor the better sources of energy in this group whenever possible The productive energy values of Fraps can be used as a guide for choosing grain products on a cost per-calorie basis (See Cornell Feed Service, November, 1948, or Texas Agricultural Experiment Station Bulletin 678)

TABLE 48 RECOMMENDED FORMULA PATTERNS FOR MASHES FOR HENS

INGREDIENT	LAYER (WITH GRAIN)	BREEDER (WITH GRAIN)
	Lb/ton	*Lb/ton*
High-energy grain products (corn, wheat, wheat red dog flour, milo, oatmeal)	500+	500+
Medium- and low-energy grain products (oats, barley, wheat flour middlings, standard middlings, bran)	0–800	0–800
Vegetable proteins (soybean meal, corn-gluten meal, peanut meal)	400–500	300–400
Animal proteins, minimum levels (fish meal, fish solubles, meat scraps)		100–150
Other B-vitamin carriers (dried milk products dried yeast, dried distillers' solubles, fermentation solubles)		150
Dehydrated alfalfa meal	100–150	100–150
Additional riboflavin (if needed)[1]	+	+
Additional vitamin B_{12} (if needed)[1]		+
Additional vitamin A (if needed)[1]	+	+
Vitamin D_3 (feeding oils or D activated animal sterols)	+	+
Calcium and phosphorus supplements (steamed bone meal, dicalcium phosphate, defluorinated phosphate, limestone)	100	100
Salt	20	20
Manganese sulfate (65 per cent feeding grade)	0.5	0.5
Required composition		
Protein (per cent)	20	20
Calcium (per cent)	2–2.5[2]	2–2.5[2]
Phosphorus		
Total per cent	1.2	1.2
Available per cent[3]	0.8	0.8
Vitamin A (I.U./lb.)[4]	6600	6600
Vitamin D (I.C.U./lb.)	680	680
Riboflavin (mg/lb.)	1.3	2.1
Vitamin B_{12} (μ/lb.)[5]		3–4

[1] Refers to the use of riboflavin supplements, vitamin-B_{12} supplements, and vitamin-A sources of guaranteed vitamin content, or other vitamin-rich feedstuffs when the formula is otherwise deficient in any of these nutrients.

[2] Free-choice feeding of oystershell or other calcium supplement recommended, since this level of calcium will not meet full requirements.

[3] Approximately 30 per cent of the phosphorus of vegetable products is nonphytin phosphorus and may be considered as part of the inorganic or available phosphorus required.

[4] If corn constitutes half of scratch-grain mixture the level of vitamin A in the mash can be reduced by 1000 I.U. lb.

[5] Refers to vitamin B_{12} supplied by fish products, meat scrap, and vitamin-B_{12} supplements.

Egg production is affected by the available energy content of the ration, although the difference between rations is not so great as in the case of growth. Rations made up of a mixture of ground wheat and corn to supply the cereal portion of the ration, as compared to wheat by products, can be expected to produce about a dozen more eggs per bird in a year.

The choice of the components of the cereal portion of the

mash will be determined largely by price and availability. Feeding experience has shown that using a mixture of several cereal products in formulating a poultry ration is more generally satisfactory from all standpoints than relying on one grain or grain product exclusively.

The physical nature of the ground grains in poultry mashes also is an important factor to consider. In general, a high proportion of finely ground material should be avoided. In the case of wheat, the use of a coarsely ground or crushed product is particularly advisable. Finely ground wheat is likely to form a sticky paste when moistened, and will lead to impaction of feed in the beak when used at a high level in the mash.

Vegetable proteins. Soybean meal can be used as the only vegetable-protein supplement or in combination with corn-gluten meal or peanut meal. Corn-gluten or peanut meal should not make up more than one-fourth of the total of this group of feedstuffs. Cottonseed meal should be avoided in rations for hens.

Animal proteins. These products serve as sources of protein, minerals, vitamin B_{12}, and at least one other still-unidentified nutrient. The minimum levels recommended for breeder mashes are the amounts needed to aid in supplying the unknown nutrient(s). The lower recommended figure in Table 48 refers to the minimum level of fish products when used alone; the higher figure indicates the approximate level of meat scrap when used alone. A combination of products appears to be preferable. Depending on cost and availability, levels higher than the indicated minimum amounts can be used in all poultry mashes; the amounts of protein, calcium, phosphorus, and vitamin B_{12} contributed by the animal products will accordingly determine the amounts of these nutrients needed from other sources.

The recommended levels of vitamin B_{12} refer to the amounts supplied by fish products, meat scrap, and vitamin-B_{12} supplements. It is desirable to know the B_{12} content of the particular fish and meat products used, and this may be determined by laboratory assay. When such values are not available, an approximation of the B_{12} content can be calculated by assigning values of 40 micrograms of B_{12} per pound of fish meal, 70 per pound of fish solubles, and 15 per pound of meat scrap.

Other B vitamin carriers These ingredients are valuable sources of many of the known B-complex vitamins The levels recommended are intended to aid in supplying the unknown nutrient(s) referred to previously Since it appears likely that more than one unidentified nutrient may be involved it is considered wise to use these carriers in combination with animal proteins

Dehydrated alfalfa meal This product is an important source of vitamin A activity but it is desirable to limit its use because of its low available energy value It is therefore necessary to use a high quality meal in order to supply sufficient vitamin A activity at a low usage level If additional vitamin A is needed it should be supplied in another form such as vitamin feeding oil rather than by exceeding the alfalfa levels recommended

Calcium and phosphorus supplements The phosphorus requirements are shown in Table 48 both as total phosphorus and available phosphorus The available phosphorus content of a mash is the amount supplied by the animal products and the inorganic supplements (bone meal defluorinated phosphate etc) *plus* 30 per cent of the rest of the phosphorus of the mash Calculating available phosphorus gives a more accurate appraisal of the phosphorus value of a mash than does the total phosphorus content

The phosphorus sources listed in the pattern table are nearly equivalent in phosphorus availability In choosing a phosphorus supplement care should be taken to insure that the product is intended for poultry feeding and has a sufficiently low content of fluorine

Vitamin D The recommended vitamin D levels are shown in International Chick Units based on the new vitamin D_3 standard now in official use Feeding oils and D activated animal sterols are equally effective sources of vitamin D unit for unit.

Other riboflavin and vitamin B_{12} sources Riboflavin supplements and vitamin B_{12} supplements of guaranteed vitamin content are generally available and can be highly useful in meeting the requirements for these vitamins The levels of other vitamin rich feedstuffs in the formula particularly when amounts greater than the minimum levels are supplied will determine

TABLE 49 Cornell Mashes for Hens

Ingredient	Breeder Mashes (Fed with Grain)				Layer Mashes (Fed with Grain)			
	Lb/ton	*Lb/ton*	*Lb/ton*	*Lb/ton*	*Lb/ton*	*Lb/ton*	*Lb/ton*	*Lb/ton*
Yellow corn meal	800	620	570	640	770	640	850	630
Ground wheat		200				200		
Wheat flour middlings	200		300	200	300		200	200
Wheat standard middlings		200		200		200		200
Pulverized oats	200	200	200		200	200	200	
Ground barley			100	200				200
Soybean meal	325	250	300	200	400	400	370	380
Corn gluten meal		50						50
Peanut meal				50		100		
Fish meal	75	100					50	50
Fish solubles			75					
Meat scrap	75		75	150	100		50	
Corn distillers' dried solubles	50		100	75			50	
Dried whey	50	100	50	75				50
Dried brewers' yeast		50						
Dehydrated alfalfa meal	100	100	100	100	100	100	100	100
Riboflavin supplement to supply (mg riboflavin)	1100 mg		600 mg	600 mg	400 mg	400 mg	200 mg	
Vitamin B_{12} supplement to supply (mg B_{12})	4 mg	4 mg		5 mg				
D activated animal sterols (1500 I C U /gm)	2	2	2	2	2	2	2	2
or								
Vitamin feeding oil (300 D, 1500 A)	10	10	10	10	10	10	10	10
Steamed bone meal	75	90	90	70	90	120	90	100
Limestone	30	20	20	20	20	20	20	20
Salt (iodized)	20	20	20	20	20	20	20	20
Manganese sulfate (65 per cent feeding grade)	0 5	0 5	0 5	0 5	0 5	0 5	0 5	0 5

whether and in what amount special vitamin supplements should be used

Feeding recommendations. *Layer* To be fed with approximately equal grain intake according to any good mash and grain feeding program

Breeder To be fed with approximately equal grain intake according to any good mash and grain feeding program Breeding ration should be fed for at least four weeks before eggs are taken for hatching

RECOMMENDED RATIONS FOR EGG PRODUCTION

Many satisfactory rations have been fed to hens They will vary according to the feeds that are available As typical examples the recommended rations in Tables 49–57 are given as representing rations that are used in different sections of the United States

TABLE 50 Georgia Laying and Breeding Mashes

SIMPLIFIED LAYING MASHES

Ingredient	Ration 1	Ration 2	Ration 3	Ration 4	Ration 5
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Ground yellow corn	40	40	20	30	10
Ground wheat	20		20	20	20
Ground oats	20	40	20		10
Ground barley				30	10
Ground kafir or hegari			20		30
Meat scrap	20	20	20	20	20
Salt	1	1	1	1	1

BREEDER MASH

Ingredient	Pounds
Yellow corn meal	100
Wheat bran	100
Wheat middlings	100
Ground oats	100
Fish meal	40
Meat scrap	40
Alfalfa leaf meal	15
Dried buttermilk	25
Salt	5
Oil	0 3

(Department of Poultry Husbandry, University of Georgia, Athens, Georgia, 1941)

TABLE 51 Indiana Laying Rations (after 20 Weeks)

All of the rations and directions given here are for fowls which will be given range Special provisions must be made for layers confined in the house

Feed grain an hour before roosting time each day—10 lbs per 100 light fowls (Leghorns), 12 lbs per 100 heavy fowls (Rocks, Reds)

Keep mash, oystershell, and water before the fowls at all times

Give fowls access to range during all afternoons in fall and winter, regardless of weather, and all day in other seasons When pasturage is poor, supply alfalfa hay in racks, or add 10 pounds of alfalfa leaf meal to each 100 pounds of mash

Condensed buttermilk, fed in paste form at the rate of 2½ lbs per 100 fowls daily, has improved several rations When fed at this rate, the meat scraps in the mash can be reduced one fifth

Laying Ration No 1

Scratch grain	
Whole yellow corn	
Mash Formula	Pounds
Wheat bran	200
Wheat middlings	200
Meat scraps	100

Note 200 lbs ground oats and 200 lbs ground wheat may replace wheat bran and middlings in the mash in *this* ration

Laying Ration No 2

Scratch grain	Pounds
Whole yellow corn	300
Whole wheat	200
Mash Formula	
Ground yellow corn	100
Wheat bran	100
Wheat middlings	100
Meat scrap	80

Laying Ration No 3

Scratch grain	
Whole yellow corn	

Note 200 lbs wheat bran and 200 lbs wheat middlings may replace ground oats and wheat in the mash in *this* ration

Mash Formula	Pounds
Ground oats	200
Ground wheat	200
Soybean-oil meal *or* ground soybeans	80
Meat scraps	40
Steamed bone meal	20
Salt	5

(Division of Poultry Husbandry, Purdue University, Lafayette, Indiana, 1941)

Notes about Table 51. *"Big Five" mash* An old and popular mash formula, known as the "Big Five," consists of 100 pounds each of ground yellow corn, ground oats, wheat bran, wheat middlings, and meat scraps It may be fed with corn or other grains as indicated in Table 51 Provide pasturage, shell, water, etc.

"Mashless" rations These rations are practical when one has sufficient liquid skim milk to provide the fowls with all they will drink (usually 3 to 4 gallons per day per 100 fowls). *No water is given* Give access to grass range every day, provide oystershell, and feed all the fowls will consume of any of the following grain rations

1 Yellow corn only
2 Yellow corn 70 lbs , oats 30
3 Yellow corn 70 lbs , wheat 30
4 Yellow corn 60 lbs , oats 20, wheat 20

TABLE 52 Oklahoma Layer and Breeder Mash Formulas

Ingredient	CB490	CB491	CB492	CB494	CB495
Ground yellow corn	15	15			27
Wheat shorts	15	15	18		20
Wheat bran	27	27	18		10
Pulverized barley	15	15	18		
Pulverized oats				21	10
Ground wheat				21	
Ground kafir				21	
Ground wheat or kafir			18		
Alfalfa leaf meal	6	6	6	15	10
Cottonseed meal	5		5		5
Soybean meal		5	5	5	5
Meat and bone scrap	10	10	10	16	5
Dried buttermilk	5	5			
Fish meal					5
Ground limestone or pulverized oystershell	1	1	1		2
Salt	1	1	1	1	1
Manganese stock solution	0.1	0.1	0.1	0.1	0.1
Vitamin concentrate [1]					

[1] To supply vitamins A and D according to manufacturers recommendations.

(R H Thayer and R B Thompson *Feeding Chickens* Oklahoma Circular C-133, May, 1949)

Notes about Table 54 *Grain* Scratch grain for all rations may be individual grains or combinations of wheat, oats, yellow corn, and barley The proportions of each used will depend on price, availability, and palatability Birds will usually eat any type of grain if they are started on it at an early age You may feed scratch grain either in hoppers or in the litter

Amount of feed Leghorn flocks in heavy production will eat from 25 to 28 pounds of feed per 100 birds daily, heavy breeds, 28 to 32 pounds Pullets in good lay should eat about 40 per cent grain and 60 per cent mash You may encourage immature pullets to eat more than 40 per cent grain If you reduce the amount of grain in their ration, older hens will eat more mash Molting flocks or flocks in light production may eat as little as 18 to 22 pounds Pullets that do not eat enough will lose weight and are likely to go into a slump after 4 to 10 weeks of heavy production You can increase grain

TABLE 53 WASHINGTON LAYING MASH FORMULAS

INGREDIENT	RATION 1	RATION 2	RATION 3	RATION 4 [1]
	Pounds	*Pounds*	*Pounds*	*Pounds*
Ground wheat	19.1	19.2	19.2	19.5
Ground yellow corn	10.0	10.0	10.0	10.0
Ground oats	5.0	5.0	5.0	5.0
Ground barley	10.0	10.0	10.0	10.0
Millrun	20.0	20.0	20.0	20.0
Fish meal	3.5		1.7	
Meat scrap		4.3	2.2	
Soybean oil meal	18.8	18.8	18.8	21.6
Dehydrated alfalfa	6.0	6.0	6.0	6.0
Ground oystershell or limestone	2.8	2.8	2.8	2.7
Bone meal or defluorinated phosphate [2]	3.8	2.9	3.3	4.2
Salt (iodized)	1.0	1.0	1.0	1.0
Vitamin-D supplement	Note 1	Note 1	Note 1	Note 1
Manganese sulfate	Note 2	Note 2	Note 2	Note 2

Note 1 If a vitamin supplement is used that contains 1000 A.O.A.C. chick units per gram of vitamin D and 5000 units per gram of vitamin A, add the following amounts per 100 pounds of mash

May through September	1.6 ounces
October through April	3.2 ounces

The amounts required of vitamin supplements of other potencies vary proportionately

Note 2 Add 0.4 ounce of manganese sulphate per 100 pounds, or 8 ounces per ton

[1] This ration will not be equal to Rations 1, 2, and 3 unless fed with the amount of liquid milk or condensed buttermilk suggested in the feeding schedule.

[2] The amounts listed are for bone meal. If you use dicalcium phosphate instead of bone meal or defluorinated phosphate, only 67 per cent as much is required, but it will be necessary to increase the calcium from ground oystershell or limestone flour by approximately 28 per cent.

(Poultry Pointers No. 20 [Revised], State College of Washington, Pullman, Washington, July, 1949.)

TABLE 54. SUGGESTED FEEDING SCHEDULE FOR WASHINGTON RATIONS NOS. 1, 2, 3, AND 4 (FOR 100 PULLETS—ALL BREEDS)

WHAT	WHEN	HOW MUCH
Lights (if necessary)	On at 7 A.M. Off at 8 P.M.	13-hour day
Laying mash	When necessary	To prevent wastage, fill hoppers only half-full
Heavy whole oats	Morning	3 pounds
Wheat or scratch grain	Afternoon	According to production and body weight, about 7/8 pounds for Leghorns, 8/10 pounds for heavies
Oystershell or limestone grit	When necessary	Keep it constantly before birds
Granite or silica grit	When necessary	Keep it constantly before birds
Milk	Morning or noon (For Laying Ration 4 only)	6 quarts of liquid milk or 3½ pounds of condensed buttermilk

consumption safely by adding an evening feeding of grain in the hoppers Feed whatever amount the birds will clean up before roosting You can increase mash consumption by having more hopper space, feeding mash more frequently, sprinkling pellets on the mash, or feeding a moist mash

Hopper space Poor production often results from a lack of hopper space Allow 24 feet for mash for each 100 birds in the laying house The construction of mash hoppers is described in State College of Washington Poultry Pointers No 23, *Laying House Equipment*

Water space Have at least 5 feet of drinking space for each 100 birds Nothing will cause a slump in production or a molt quicker than letting the birds go without water Keep the water always clean and fresh and do not allow it to freeze

Milk Feed liquid milk or condensed buttermilk with Ration 4 Feed liquid milk at the rate of 6 quarts daily for 100 birds When you feed liquid milk, wash the crocks or wooden containers daily and scald them at least twice a week If you use condensed buttermilk, feed it at the rate of 3 5 pounds to 100 hens One pound of dry milk is equal to about 3 pounds of semisolid or 10 pounds of liquid milk

Green feed Succulent green feed is a valuable supplement to laying mashes because it is an excellent source of proteins, minerals and vitamins It is particularly valuable for hens as a source of vitamin A Any green feed, except carrots, however, will cause darker-colored egg yolks, and silage may even cause green yolks

During much of the season, you may feed 5 pounds of tender green feed, such as cut kale, clover, alfalfa, and lawn clippings at noon In the fall, winter, and early spring, when green feeds are not available, you may feed carrots, about 5 pounds to 100 birds, or green alfalfa hay, either cut or uncut There is usually less wastage when the hay is cut in ½ inch to ¾ inch lengths For information on the construction of green feed feeders, see State College of Washington Poultry Pointers No 23, *Laying House Equipment* For information on the growing of green feeds for poultry, send for Washington Extension Bulletin 310, *Growing Green Feed for Poultry*

Moist mash It is not necessary to feed a moist mash to keep up production Feeding moist mash means extra labor and

TABLE 55 Washington Breeding Mash Formulas

Ingredient	Ration 1	Ration 2	Ration 3	Ration 4	Ration 5[1]
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Ground wheat	18 1	10 0	9 4	13 8	16 6
Ground yellow corn	5 0	5 0	5 0	5 0	5 0
Ground oats	5 0	5 0	5 0	5 0	5 0
Ground barley	5 0	5 0	5 0	5 0	5 0
Millrun	35 0	35 0	35 0	35 0	35 0
Fish meal	6 0		3 7		
Meat scrap		7 7		7 7	
Soybean-oil meal	8 0	5 6	8 0	9 0	16 0
Dehydrated alfalfa	10 0	10 0	10 0	10 0	10 0
Dried whey		3 5	3 5	3 5	
Fermentation by-products[2] (113,500 micrograms riboflavin per pound)	5			4	
Distillers' dried solubles (7000 micrograms riboflavin per pound)		8 0	8 0		
Limestone flour or ground oyster shell	3 5	3 3	3 8	3.3	3 0
Bone meal or defluorinated phosphate[3]	2 9	9	2 6	1 3	3 4
Salt (iodized)	1 0	1 0	1 0	1 0	1 0
Fish oil	Note 1	Note 1	Note 1	Note 1	Note 1
Manganese sulfate	Note 2	Note 2	Note 2	Note 2	Note 2

Note 1 If a vitamin supplement is used that contains 400 A O A C chick units per gram of vitamin D, add the following amounts per 100 pounds of mash

May through September	4 ounces
October through April	8 ounces

If supplement used contains 2000 units per gram, the amounts added per 100 pounds should be

May through September	0 8 ounces
October through April	1 6 ounces

Note 2 Add 0 4 ounce of manganese sulfate per 100 pounds or 8 ounces per ton

[1] Formula 5 must be supplemented with 6 quarts of liquid milk or 3½ pounds of condensed buttermilk per 100 birds per day

[2] If different unitage riboflavin concentrate or crystalline riboflavin is used adjust the poundage between the ground wheat and the riboflavin supplement

[3] The amounts listed are for bone meal if dicalcium phosphate is used only 67 per cent as much is required but it will be necessary to increase the calcium from ground oystershell or limestone flour by approximately 28 per cent.

(Poultry Pointers No 25 [Revised], State College of Washington, Pullman, Washington, September, 1946)

presents the danger of the growth of harmful mold and bacteria, especially during hot weather Moist mash may be used to keep birds eating enough mash in emergencies such as sickness, extreme cold, interrupted lighting schedule, or the moving of birds

Pellets. You may feed mashes or pellets with equally good

results in egg production or the pellets may be fed instead of moist mash once a day on top of the mash as a supplement Feather picking and mortality from cannibalism may increase, however, if the laying mash is fed as pellets

Feeding schedule (using suggested feeding schedule as a guide) Even with the best of mashes, you can, by feeding too much scratch grain unbalance the laying ration by reducing the mash consumption of your flocks Feed pullets in good lay 60 per cent mash Make changes in the feeding schedule gradually

Mash concentrates Poultry mash concentrates are being used to some extent by those farmers who wish to make use of home grown grains A number of commercial concentrate mixtures are available The proportion of home grown grains that may be combined with a concentrate may be varied con siderably Because grains are low protein feeds and are defi cient in many of the other essential substances, a poultry mash concentrate must contain more protein than an ordinary mash and also more of the vitamins When mixed with ground grains in the proportions indicated, the resulting mash mixture will be similar to the regular mashes

The formulation of mixing mashes is based on the same basic information as the compounding of complete poultry mashes The general composition of poultry mixing mashes is given in Table 56 and examples of the same are given in Table 57

These mixing mashes when mixed with ground grains in the proportion of 60 parts of grain to 40 parts of mixing mash, produce a mash mixture similar to the respective complete poultry mashes The following proportions of ground grains are sug gested to be mixed with 800 pounds of mixing mash to produce one ton of final mash

Ground Grain	*Amount to Mix with 800 Pounds Mixing Mash*							
Corn	600	800	400	400	600	200	600	600
Wheat	600	400	800	400	300	600	200	400
Oats				400	300	400	400	200

As indicated in the mixing mash table, attention must be given to the vitamin A content of the mixing mash for laying and breeding hens if the amount of yellow corn used is less than half of the ground grain mixture added to the mixing mash and if the yellow corn is less than half of the scratch grain mixture

TABLE 56 APPROXIMATE COMPOSITION OF POULTRY MIXING MASHES

INGREDIENT	LAYING	BREEDING
	Per Cent	*Per Cent*
Crushed wheat Wheat by products	10–15	0–5
Soybean-oil meal Corn-gluten meal Peanut meal	50	30–35
Fish meal Fish solubles Meat scrap Dried skim milk Dried buttermilk	10–15	20–25
Dried brewers' yeast Dried whey Dried distillers' solubles Fermentation solubles		15–20
Dehydrated alfalfa meal Additional riboflavin supplement	12.5 (if needed)	12.5 (if needed)
Steamed bone meal Dicalcium phosphate Defluorinated phosphate Ground limestone	10	10
Salt	2.5	2.5
Manganese sulfate (feeding grade, 67 per cent $MnSO_4$)	09	09
Vitamin D_3 (D-activated animal sterol or fish liver oil)	+	+
Required composition	+	
Protein (per cent)	32	32
Calcium (per cent)	*	*
Phosphorus (per cent)	2.4	2.4
Riboflavin (mg/lb)	2.5	4.5
Vitamin D (units/lb)	1700	1700
Vitamin A (units/lb)		
If no yellow corn used	16,500	16,500
If half of mixing grain and scratch grain is corn	11,600	11,600
Mixing proportion per ton		
Pounds mixing mash	800	800
Pounds ground grains	1200	1200
Method of feeding resultant mash	With grain	With grain

* No definite value; free choice feeding of oystershell or other calcium supplements recommended.

In this case, the level of alfalfa meal used will not supply sufficient vitamin A, and the addition of another source of vitamin A will be necessary

TABLE 57 EXAMPLES OF POULTRY MIXING MASHES (800 POUNDS TO BE MIXED WITH 1200 POUNDS GROUND GRAINS)

INGREDIENT	LAYING	BREEDING
	Per Cent	*Per Cent*
Crushed wheat	11 75	4.25
Soybean-oil meal	50	32
Fish meal		12.5
Meat scraps	12.5	12.5
Dried whey		15
Dehydrated alfalfa meal [1]	12 5	12.5
Steamed bone meal	10.5	8 5
Ground limestone		
Salt	2.5	2.5
Manganese sulfate (feeding grade, 67 per cent $MnSO_4$)	09	09
Riboflavin supplement to supply		100 mg/100 lb
D-activated animal sterol	25	25
Total	100 0	100 0
Calculated analysis		
Protein (per cent)	32.1	32.3
Calcium (per cent)	4.5 [2]	4 7 [2]
Phosphorus (per cent)	2.4	2 4
Riboflavin (mg/lb)	2.2	4 5
Vitamin A (units/lb)	12,500	12,500
Vitamin D (units/lb)	2250	2250

[1] Assuming 100 000 units vitamin-A activity per pound.
[2] Recommend feeding oystershell or other calcium supplement free-choice.

SUGGESTIONS AND QUESTIONS

1 Assemble feeding data in your area and note the laying rations which give the best results How does your ration compare with others?

2 Compare the ready mixed laying rations offered for sale in your locality with respect to price guaranteed analyses, and ingredients

3 List the home-grown feeds available and suggest rations made up largely of them

4 Visit farms of successful egg producers and note their practices and methods

5 Make a poultry feeding survey including such information as egg production, kinds of feeds used, feed costs and methods of feeding

6 Outline a plan for the routine of daily as well as seasonal feeding management for your flock

7 Calculate the amount and cost of feed per dozen eggs for each month of the year

8 Make a study of commercial feeding equipment

9 Formulate a good laying ration using feeds available in your market. Compute the various nutrients to make sure that the recommended allowances are met

10 Observe the various systems and equipment for providing artificial illumination

11 How are broody hens managed in your area?

12 What differences do you find in the feeds and management between flocks producing market eggs and hatching eggs

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CHAPTER 11

Producing Market Poultry

MARKET POULTRY

MARKET poultry includes many different kinds of birds, such as chickens, turkeys ducks, geese, pigeons, and guineas It in cludes a wide range in regard to size, age, and type of meat Other kinds of poultry also contribute to the meat supply al though the total volume is not great We must recognize the total contribution of game birds to the food supply

The poultry industry in the United States has been based principally on the farm flock, which is a part of diversified farming In some areas however, egg production, as well as other branches of the industry, have become highly specialized

Poultry meat production has been essentially a sideline of the poultry industry in connection with the production and replacement of the laying flock In the raising of pullets there were normally nearly the same number of cockerels and pullets The surplus cockerels were sold as broilers Fowls culled from the laying flock were available for the market after a more or less extended period of production The extra and poorer pul lets were sold as meat Roosters were disposed of after the breeding season Under these conditions, most of the poultry meat was marketed during the fall and winter months, result ing in a surplus during a part of the year and a deficit in an other

The production of poultry meat as a principal product has also developed This is particularly true of broiler production

Turkey production has increased considerably during the past decade For a discussion of this, see Chapter 15

In recent years, the production of broilers has increased rapidly 'Broilers' have come to include young chickens of all weights Hence, they include what are technically referred to as broilers, fryers, and light roasters

Advances in nutrition and disease control, which have made it possible to raise chickens in confinement at any season of the year, have been the chief reasons for the development of the broiler industry, which started about 1923 and has grown steadily since Commercial sexing of chicks has supplied egg producers with all pullet chicks many of the cockerels being sold to the specialized broiler grower The broiler industry has provided the consumer with fresh killed poultry the year round

In many establishments the production of poultry meat is the chief business, and in others it is combined with other enterprises It provides a supplemental use of labor during winter and spring

The production of so called broilers has been concentrated in certain areas, as Delaware, Virginia, and Maryland (known as the Del Mar Va area), Connecticut, New York, California, Georgia, Pennsylvania, Indiana, and Arkansas

Chicks are usually bought from commercial hatcheries The heavy breeds are used, since most of the birds are raised to weights of 3 to 4 pounds Various purebred varieties, as well as crossbreeds, are grown The leading varieties represented in broiler production are Plymouth Rocks, both Barred and White, New Hampshires, Rhode Island Reds, and White Wyandottes The cross most commonly used is the one involving Barred Plymouth Rock and New Hampshire breeds

In producing broilers, rapid growth is emphasized, since this is more efficient and also produces more tender carcasses Birds with red combs and yellow skin and legs, both signs of good health, are preferred Weights of 3 pounds or over are most profitable About 3 to 4 pounds of feed is required to produce a pound of chicken The profits, however, will depend upon mortality and the efficiency of feed and labor Approximately 90 per cent of the cost of production is represented in the cost of the chick, feed, fuel, and labor

Meat birds are raised on the floor, in batteries, and on range

High-quality poultry meat is relished by everyone

or under various combinations of these systems

Rations. Building broiler rations involves a number of critical factors related to the extremely rapid growth rate of chickens used for meat production and the conditions prevalent in commercial broiler production

Rapid growth and development are highly desirable characteristics in broiler production, and selection has improved the types of chickens used for this purpose One of the major advantages of increasing the rate of growth is the improvement in efficiency of converting feed into meat. Particular care must be taken, however, in formulating rations for broiler production to make certain that all essential nutrients are adequately supplied

Commercial broiler production often is characterized by close confinement, with limited floor space per bird, under conditions where sanitation and disease control are difficult. Under such circumstances the effect of the ration on the amount and moisture content of the droppings is an important factor because of its direct relation to the condition of the litter

A general pattern for the formulation of broiler rations is given in Table 58 In this table the feed ingredients have been grouped according to their purpose in the ration and the approximate amounts required for each group

Available energy. The cereal grains and their products are the major sources of energy in poultry rations, and their choice mainly determines the energy content of the ration. Ground corn, milo, wheat, rolled oats, and wheat red-dog flour are excellent sources of available energy, heavy oats, barley, and wheat flour middlings are somewhat less efficient, light oats,

TABLE 58 A PATTERN FOR THE FORMULATION OF BROILER RATIONS

INGREDIENT	APPROXIMATE PROPORTION
	Per Cent
Ground yellow corn	
Ground milo	
Crushed wheat	60
Wheat red-dog flour	
Wheat flour middlings	
Ground heavy oats	
Soybean meal	25
Fish meal (or fish solubles)	2
Fish meal	
Fish solubles	
Meat scraps	4
Dried skim milk	
Dried buttermilk	
Dried brewers' yeast	
Dried distillers' solubles	5
Dried whey	
Fermentation solubles	
Dehydrated alfalfa meal (17 per cent protein or more)	2
Riboflavin supplement	(if needed)
Steamed bone meal	
Dicalcium phosphate	0.5
Defluorinated phosphate	
Ground limestone	1
Salt, iodized	0.25
Manganese sulfate (feeding grade, 67 per cent $MnSO_4$)	0.02
Additional vitamin A	(if needed)
Vitamin D_3	+
Required composition	
Protein (per cent)	20
Calcium (per cent)	1.0
Phosphorus (per cent)	0.6
Available phosphorus (per cent)	0.4
Riboflavin (mg/lb)	1.6
Vitamin A activity (units/lb)	2000
Vitamin D_3 (units/lb)	135

wheat bran, alfalfa meal, and wheat standard middlings are poor in this respect

The available energy content of a ration is particularly important in broiler production in which the most rapid and efficient growth is desired, in a broiler ration, therefore, use should be made of cereal grains of high available energy High energy, low fiber broiler rations have been receiving considerable attention recently Many of these are also high corn diets

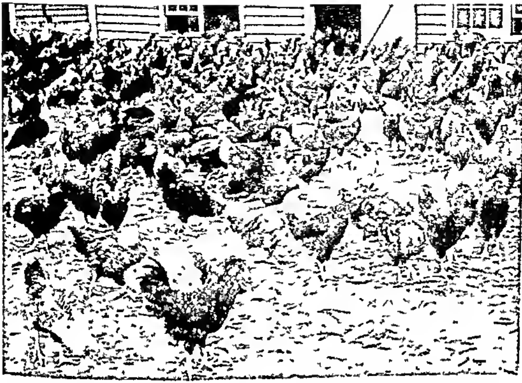
To make a high-energy ration, greatest use should be made of cereal products of high available energy. Feedstuffs of low-energy content should be avoided in so far as possible, and only moderate use should be made of feedstuffs of medium-energy content. In general, most consistently satisfactory results have been obtained by the use of a combination of two or more cereal products, as compared to exclusive use of one. This practice is recommended, with the limitation that not more than 20 per cent of the ration should be composed of medium-energy cereal products.

In addition to allowing rapid growth, rations of high available energy reduce the quantity of droppings voided by the birds, because the amount of indigestible material in the ration is small.

Protein. Soybean meal and other vegetable-protein carriers are the most plentiful protein supplements available for poultry feeding. They can be used to supply most of the supplementary protein needed in broiler rations. Other vegetable proteins can be used, but the amount in the ration must be limited in some cases because of the inherent characteristics of the material (as in the case of linseed meal) or because of limited supplies. Corn-gluten meal is often used to produce increased pigmentation, which is considered by some to be desirable from a market-standpoint. Suggested levels of vegetable-protein supplements for use in combination with soybean meal are corn-gluten meal 5 per cent, peanut meal 10 per cent, cottonseed meal 10 per cent, linseed meal 3 per cent.

Animal-protein supplements. For maximum growth a part of the protein in broiler rations must be supplied by animal-protein supplements. The major reason for this is not a need for animal protein as such, although animal proteins are usually more efficient than proteins from plant sources, but rather the need for certain unidentified vitamins associated with animal-protein supplements. These vitamins are commonly known as the "animal-protein factor," and the recently isolated vitamin B_{12} is apparently one of these factors.

A total of 6 per cent of animal-protein supplements is desirable in broiler rations. Because fish meal and fish solubles are the most potent carriers of unidentified vitamins among readily available ingredients, it is recommended that at least 2



Crossbred broilers ready for market. Each bird weighs from 3 to 4 pounds.

per cent of one of these products should be used. The additional 4 per cent may be supplied either by more of these materials or by meat scraps, dried skim milk, or dried buttermilk.

Vitamins. Animal-protein supplements contain at least two unidentified vitamins required for maximum growth, and the amounts and proportions of these factors vary among different animal protein supplements and among successive lots of a given material. Dried brewers' yeast, dried distillers' solubles, dried whey, and fermentation solubles contain at least one of the unidentified vitamins concerned. One, or a combination of these ingredients, should be used at a level of 5 per cent to avoid the possibility of a deficiency of the factors carried by them, because of the variability of the animal-protein supplements.

If the recommended levels of animal-protein supplements and other carriers of unidentified vitamins are used, any of the riboflavin supplements may be used on the basis of their riboflavin content.

The use of dehydrated alfalfa meal should be minimized in

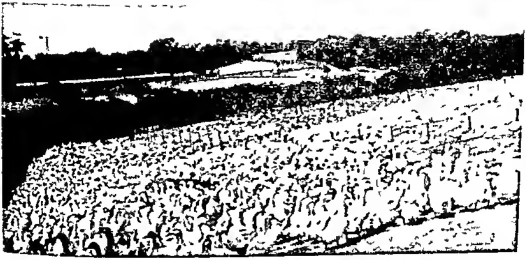
TABLE 59 CORNELL BROILER RATION FORMULAS

INGREDIENT	AMOUNTS		
	Per Cent	*Per Cent*	*Per Cent*
Ground yellow corn	40	42.7	44.5
Crushed wheat	15		20
Wheat flour middlings		15	
Ground heavy oats	5	5	
Soybean meal	25	17	20
Corn-gluten meal		5	
Fish meal	2	6	3
Meat scraps	4		3
Dried brewers' yeast			5
Dried distillers' solubles		5	
Dried whey	5		
Dehydrated alfalfa meal [1]	2	2	2
Riboflavin supplement (in terms of riboflavin supplied per 100 pounds of ration)	50 mg	80 mg	15 mg
Steamed bone meal	0.7	0.7	0.5
Ground limestone	1.3	1.4	1.5
Salt, iodized	0.25	0.25	0.25
Manganese sulfate (feeding grade, 67 per cent $MnSO_4$)	0.02	0.02	0.02
D activated animal sterol (1500 I C units D_3 per gram)	0.04	0.04	0.04
or			
Fish oil (300 D, 2000 A per gram)	0.20	0.20	0.20
Calculated composition			
Protein (per cent)	20.4	20.4	20.8
Fiber (per cent)	4.3	4.9	3.6
Calcium (per cent)	1.3	1.2	1.3
Phosphorus (per cent)	0.7	0.7	0.7
Available phosphorus (per cent)	0.46	0.43	0.44
Riboflavin (mg/lb)	2.1	2.0	2.1
Vitamin A activity (units/lb) [1]	3400	4000	3400
Vitamin D_3 (units/lb)	270	270	270

[1] Assuming 100 000 units vitamin A activity per pound of alfalfa calculated composition value based on alfalfa meal without use of fish-liver oil

(Cornell Feed Service, Cornell University, Ithaca, New York, April, 1949)

broiler rations because of its low available energy content The usage level suggested is 2 per cent of the ration This level will meet the vitamin A requirement if the material used is of high quality and has a suitable guaranteed vitamin A activity If the alfalfa meal available cannot be depended upon to meet the vitamin A need at this level, it is preferable to use a fish oil as the source of the needed vitamin A rather than to increase the level of alfalfa meal The choice as to the form in which vitamin D should be supplied to the ration will depend upon the means used to meet the vitamin A requirement, as well as upon the cost and availability of vitamin D supplements Fish



A flock of Pekin ducks on a Long Island duck farm. The soil is sand and the yard slopes down to the water.

oil, if fed, should not be used in the broiler ration the last two weeks before marketing, as the flesh might be tainted by it.

Minerals. Recent studies have shown that chicks utilize phytin phosphorus only to a limited extent. Phytin is the organically bound form of phosphorus which accounts for approximately 70 per cent of the phosphorus content of vegetable materials, such as cereal products and vegetable-protein supplements. Therefore, in meeting the phosphorus requirement of the chick, attention must be given, not only to the total phosphorus content of the ration, but also to the availability of the form in which it is supplied. The phosphorus contained in feedstuffs of animal origin, such as animal-protein supplements, and in inorganic mineral supplements may be regarded for practical purposes as being completely available.

The available phosphorus content of the ration should be at least 0.4 per cent. To estimate the available phosphorus content, compute the total phosphorus contribution of the animal products and the mineral supplements, and to this add 30 per cent of the rest of the phosphorus content of the ration. The total phosphorus content of the ration is relatively unimportant, but in rations of this type it will approximate 0.7 per cent or more.

Available evidence indicates that calcium levels in excess of 1.5 per cent of the ration retard growth. It is also likely in rations of high available energy content that laxativity is related

TABLE 60 CONNECTICUT BROILER RATION AND RECOMMENDED HIGH ENERGY RATIONS

INGREDIENT	RATION 1 (ORIGINAL CONNECTICUT BROILER)	RATION 2 (1950 RECOMMENDED BROILER)	RATION 3	RATION 4
Ground yellow corn	69 35	66 15	46 00	63 00
Wheat standard middlings			15 00	
Fish meal (60 per cent)	8 00	8 00	5 00[5]	7 50
Meat and bone scraps (50 per cent)	8 00	8 00	2 50[5]	
Soybean-oil meal (43 per cent)	8 00	10 00	20 00[5]	
Corn gluten meal		2 50	2 50	2 50
Alfalfa meal (100,000 A)	1 00	2 50	2 50	5 00
Butyl solubles [1]	2 00	2 00		2 00
Unextracted liver meal [2]	3 00			
Soybean oil meal (50 per cent)				17 6
Butyl solubles (500 riboflavin)			0 5	
Distillers solubles [1]			5 00 [1]	
Bone meal			0 5	1 0
Ground limestone			1 0	1 0
Salt [3]	0 5	0 5	0 27	0 5
Dry D (2000D/gm.)	0 03	0 015	0 023	0 023
A & D oil (2000A–400D)[4]		0 10	0 10	0 10
Manganese sulfate	0 025	0 025	0 025	0 025
Nicotinic acid	900 mg	900 mg	900 mg	1500 mg
Choline chloride (100 per cent)	32 gm	16 gm		16 gm
A P F (aureomycin or streptomycin)		0 2	0 2	0 2

[1] Fermentation products Rations using either 2 5 per cent or 5 0 per cent corn distillers dried solubles made from a 90 per cent corn and 10 per cent barley malt base have given good results, and these ingredients may be used to replace the butyl fermentation product The ration should be fortified with riboflavin so that it contains not less than 2 mg of riboflavin per pound of finished ration Make the necessary adjustments to 100 pounds in the corn meal A combination of 2 5 per cent dried brewers yeast 2 5 per cent corn distillers dried solubles and 1 per cent liver has given excellent results with the formulas listed

[2] Condensed fish solubles. Condensed fish solubles containing not less than 50 per cent solids can be used in place of unextracted liver meal in high energy rations It is recommended that either fish solubles or liver meal be used alone as combinations of the two have frequently resulted in a slight decrease in growth and feed efficiency

[3] Salt Excess salt in the ration may contribute to the development of a laxative condition If a molasses base butyl fermentation product high in salt or a high salt fish meal is used the level of added salt should be reduced to 0 25 per cent or eliminated entirely

[4] Vitamin A The use of poor-quality yellow corn and alfalfa leaf meal low in provitamin A may result in suboptimum levels of vitamin A in the finished diet The use of 0 10 per cent of a feeding oil containing not less than 2000 units of vitamin A per gram is therefore suggested.

[5] Protein The levels of fishmeal meat scrap and soybean meal used in these rations may vary between the two extremes indicated in diets 2 and 3 As a rule the rations containing the higher levels of fishmeal and meat scrap will give superior results Because of their high mineral content the levels of fish and meat should not exceed 8 per cent of each

Feeding Recommendation Broiler Use these rations as the only feed from day old to marketing time DO NOT feed scratch feed with these rations Finely cracked grains may be fed for the first day if desired

(E P Singsen and L D Matterson, *The Connecticut Broiler Ration and Experiments with High Efficiency Rations*, Connecticut Information Series No 14, May 19, 1950)

-o the total soluble mineral content For these reasons the vitaliim content of broiler rations should not exceed 1 2 to 1 3 the mea of the ration, as indicated in Table 59.

upon the ꝏunt of added salt may also be restricted to avoid

TABLE 61. OKLAHOMA BROILER RATIONS

INGREDIENT	RATION 1	RATION 2	RATION 3
	Pounds	*Pounds*	*Pounds*
Ground yellow corn	56	52	58
Pulverized oats.	5	5	5
Corn-gluten meal	10	10	10
Distillers' dried solubles		7	..
Fish meal	5	3	3
Meat and bone scrap			5
Soybean meal	19	18	16
Salt	1	1	1
Calcium carbonate	1	1	1
Steamed bone meal	2	2	.
Delsterol	05	05	.05
Vitamin-A supplement to supply 2000 International Units of vitamin A per pound of ration			. ..
Riboflavin to supply 1000 micrograms per pound of ration			..
Choline chloride (gm)	32	32	32
Niacin (oz)	1	1	1
Manganese sulfate (oz.)	0 2	0 2	0.2

(*Broiler Production*, Oklahoma Circular No C-134, May, 1949)

laxativity. Little experimental evidence is available to establish the minimum salt requirement of chicks, but field experience in broiler production indicates that 0.25 per cent added salt is a satisfactory level in rations of this type.

Feeding methods. The rations here outlined have been designed primarily for use as all mash rations throughout the growth period. The restricted mineral content, in particular, does not provide the margin of excess necessary for heavy grain feeding. Grain could be fed, however, during the final two or three weeks in amounts not exceeding 20 per cent of the daily feed intake.

Pelleted rations are used to some extent in broiler production. On the basis of limited studies, it does not appear advantageous or desirable to use mashes of the type discussed here in pelleted form as the entire feed. Such a practice appears to increase the problem of feather picking and cannibalism Pelleted mashes may be used in the latter stages of the growth period as a supplementary feed in combination with the mash mixture to stimulate feed consumption. This added feed intake has resulted in increased growth and feed efficiency.

TABLE 62 Washington Broiler and Fryer Rations

Ingredient	Ration 1	Ration 2	Ration 3	Ration 4
	Pounds	*Pounds*	*Pounds*	*Pounds*
Ground wheat	13.3	15.0	17.6	16.6
Ground corn	20.0	20.0	20.0	20.0
Ground oats	10.0	10.0	10.0	10.0
Ground barley	5.0	5.0	5.0	5.0
Millrun	15.0	15.0	15.0	15.0
Dehydrated alfalfa	5.0	5.0	5.0	5.0
Fish meal (70 per cent protein)	7.0	5.0	7.0	5.0
Meat scrap (50 per cent protein)		7.0		5.0
Soybean-oil meal	15.0	10.0	15.0	10.0
Whey powder	5.0	5.0		
Fermentation by products[1] (113,500 micrograms of riboflavin per pound)			5	
Distillers' dried solubles[1] (7000 micrograms of riboflavin per pound)				5.0
Limestone flour or ground oyster shell	2.4	2.0	2.4	2.4
Bone meal or defluorinated phosphate	1.3		1.5	
Iodized salt	1.0	1.0	1.0	1.0
Vitamin D supplement[2]				
Manganese sulfate[3]				
Total	100.0	100.0	100.0	100.0
Suggested analysis Protein 20.5 per cent Calcium 1.6 per cent Phosphorus .8 per cent				

[1] If different unitage riboflavin concentrate is used adjust poundage between ground wheat and riboflavin concentrate.

[2] Add the following amounts of Vitamin-D supplements

300 A.O.A.C. units	2.4 oz. per 100 lbs.
1500 A.O.A.C. units	.5 oz. per 100 lbs.

[3] Add manganese sulfate at the rate of 0.2 of an ounce per 100 pounds, or 4 ounces per ton.

(*Broiler and Fryer Production in Washington* Poultry Pointers No 35 [Revised], Washington Agricultural Extension Bulletin 329, August, 1945)

PRODUCTION OF MARKET DUCKS

Ducks are kept primarily for meat because of their rapidity of growth their hardiness, and the ease in handling Production is concentrated in certain areas such as Suffolk County in New York State

A young Pekin duck, when properly grown, will weigh six pounds at about nine weeks of age

The feeding of pellets to ducks has proven more satisfactory

Runs for ducks, with access to water.

than either wet or dry mashes or combinations of the two. The following rations have given good results:

Ingredient	Starter (Fed for 3 Wks)	Grower (Fed for 6 Wks)
Ground yellow corn	23.75	29.75
Wheat standard middlings	30	25
Wheat red-dog flour	15	15
Pulverized heavy oats	10	10
Fish meal (60 per cent protein)	8	2
Dried skim milk	4	2
Corn-gluten meal	....	4
Dried distillers' solubles	4	4
Dehydrated alfalfa meal	3	5
Steamed bone meal	1	2.5
Ground limestone	0.5	0.5
Fish-liver oil (2000 A-300 D)	0.5	....
D-activated animal sterol	.....	0.1
Iodized salt	0.25	0.25
Manganese sulfate	(6 oz/ton)	(1 lb/ton)
B-Y 21 (3630 milligrams of riboflavin per pound)	.....	(4 oz/ton)

CAPON PRODUCTION

A capon is a male bird from which the reproductive organs have been removed. Caponizing renders a bird more quiet

to be able to secure the bird at a convenient working height. The instruments consist usually of a knife, spreader, hook, and remover

The bird is arranged on the frame by fastening a strap over the wings and also over the legs with the body in an extended position

The operation. 1 Remove the feathers in front of the hip If those remaining persist in getting in the way, moisten them with water

2 Place the middle finger of the left hand on the bird s hip, and draw the skin to the left by pressing with this finger Hold the finger thus until after the cut is made This results in completely covering the cut in the body after the operation has been completed and the skin slips back

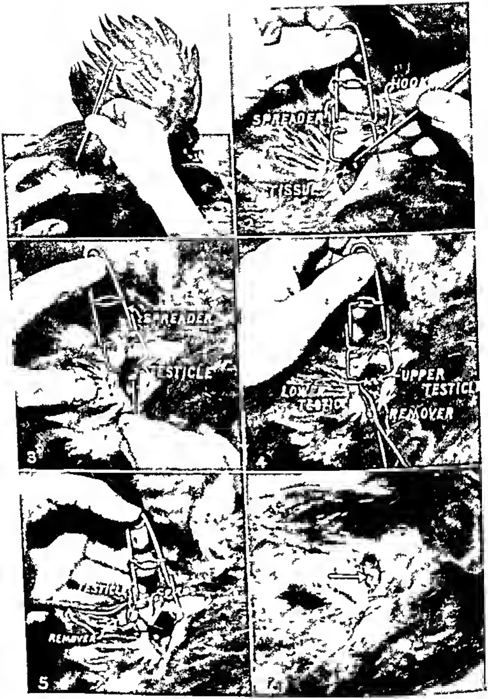
3 While still holding the skin back with the middle finger, use the forefinger of the same hand and locate the two ribs nearest the hip Keep the finger there as a guide

If the cut is made between the second and third ribs, counting from the hip, the lungs may be injured, and it may be impossible to remove the lower testicle If made between the last rib and the hip, it is too far back for easy work and may cut the large muscle controlling the leg, thus injuring the bird

4 Locate a point between these last two ribs and about ¾ inch below the backbone, and, with the sharp edge of the knife toward the operator and the handle sloping away from the operator and while the skin is still drawn back with the middle finger of the left hand, press the point of the knife quickly through the skin and the flesh to a depth of from ⅛ to ¼ inch and hold the knife in this position (See illustration 1 on page 368)

5 Cutting toward you and upward, make an incision about 1 inch in length, keeping between the ribs, cutting through the flesh and into the body cavity If the birds are properly starved, there is little danger of cutting the intestines One or two clean cuts are better than several hacking cuts which do not go through to the body cavity

6 Place the spreader with each hook around the rib Push the points of the spreader together, insert them, and turn the handle to the rear, when the spreader will hold the cut open from ¼ to ½ inch Now with the knife, continue to cut between the ribs until the opening is from 1¼ to 1½ inches long


1
2
HOOK
SPREADER
3
SPREADER
TESTICLE
4
UPPER
TESTICLE
REMOVER
5
REMOVER

Do not cut too near the back as arteries are near that point Pull the wound apart gradually with the spreader until an opening from ½ to ¾ of an inch is made Fasten the spreader jaws to hold at that point On the smaller birds care must be exercised not to open the spreader so far as to break the ribs

7 With the hook, tear away the thin tissue covering the intestines (See illustration 2 on p 368) The upper testicle should now be seen, a light-colored elongated body about the size of a kernel of wheat or a small bean lying near the back and against an artery (See illustration 3) The lower testicle should be removed first, if both are to be removed from one side then if any bleeding occurs the upper one may still be seen, whereas, if the order of removal is reversed and bleeding occurs it might be impossible to obtain the lower testicle without making an incision on the other side of the bird

The most difficult part of the operation is that of obtaining the lower testicle The exact way to go about it will depend on the style of remover used The following method applies to the style of instrument known as the Farmer Miles remover

8 With the remover, reach under and slightly to the rear of the upper testicle, press upward carefully, and, with the instrument closed and using the ring on the remover, pull the lower testicle into view (Beginners sometimes push the instrument hard against the backbone This causes unnecessary suffering and should be avoided)

9 Still pushing gently upwards open the remover ⅛ inch Let the testicle slide off the ring and catch on the solid lip beneath Then push in carefully and close the remover (See illustration 4)

(*Opposite page*) Capon production 1 Ready to make the incision Notice the position of the hands and the knife The point of the knife is inserted between the two rear ribs 2 The tissue like covering which lies above the intestines is torn away with the hook Notice the spreader in use 3 The upper testicle may usually be seen near the back 4 Removing the lower testicle The lower testicle should be removed first when the operation is made from one side only 5 Removing the testicle Notice the cords and tissues connecting the testicle with the interior These should be pulled out or cut off 6 The caponizing process completed. The cut into the body should be covered, after the bird is released, by the skin which slides over the incision

10 Open the remover slightly and move it back and forth sideways once or twice to let any blood vessels slip out, then close it firmly, twist the remover to wind the cord holding the testicle, and gently tear it out The testicle and its sac should be removed from the body cavity (See illustration 5)

If considerable difficulty is experienced in securing the lower testicle, the bird may be turned over and a cut made in the left side, when the testicle may be easily removed Some persons always remove from both sides From the standpoint of speed and less cutting, it is usually better to learn to remove both testicles from the one side

11 Remove the upper testicle likewise

12 Release the bird The skin should slide forward and, with the muscles, completely cover the cut in the body (See illustration 6)

Management of the bird after the operation The capons should be removed to a clean, airy, well lighted house, the floor of which should be covered with a clean, deep litter Perches, feed hoppers, and water or milk containers all should be low, as much flying retards the healing of the cut The birds should have free range, but other cockerels should be kept separated from them

For several days after the operation some of the capons are likely to become bloated by the formation of wind puffs on the side of the incision To prevent the bird from becoming deformed, the swelling should be punctured with the point of a knife and the air allowed to escape It may be necessary to repeat this operation at intervals of from two to three days

After the operation any desirable growing ration may be fed In order to grow good capons one should provide excellent rearing conditions as well as proper feeding

Finishing for market Some growers prefer to give a finishing period of from four to six weeks just prior to marketing During this period the capons may be confined to yards and given a wet mash mixed with milk once daily in addition to the regular grain and mash

FATTENING OR FINISHING MARKET POULTRY

Fattening or finishing poultry for the table is one of the oldest practices of poultry husbandry

Advantages of finishing In the process of fattening the

bird is made ready for marketing During this process some of the feed is transformed into fat Improvement is both external and internal

In most cases the weight of the bird is increased The actual gain in weight will depend upon a number of factors and conditions The bird should be improved in appearance by making it more plump The color of the flesh can also be influenced by the feed, making it paler or yellower according to the market preference

Besides increase in size, the proportion of edible parts is enlarged The largest portion of gain in weight during fattening is represented in the edible portion of the bird There is also improvement in the quality of the flesh More intercellular material is formed which softens the tissues resulting in greater tenderness, more juiciness and better flavor

Factors to be considered In order to obtain the best results in fattening a number of factors must be considered

Stock Birds must be healthy Those off condition, of low vitality, or infested with parasites cannot be fattened profitably The birds must be capable of fattening The general purpose or meat breeds are best for fattening purposes

Quarters The pens or houses must be comfortable, which means reasonably warm in winter and cool in summer Clean, mite free quarters are necessary to insure keen appetites The place should be quiet and free from disturbance, in order to keep the birds inactive

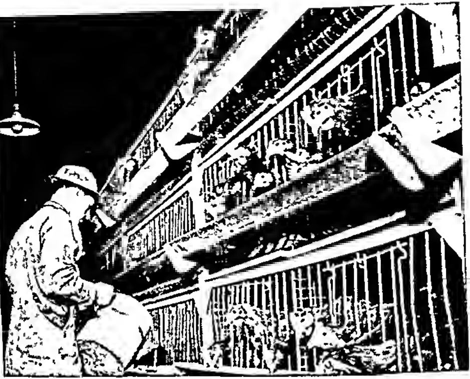
Fattening period The birds are fed as long as gains can be made In the case of battery fattening this usually means about 12 to 15 days For pen fattening, the period can be extended For large sized birds the period of fattening may also be somewhat shorter than for medium sized birds

Management practices The birds should be fed all that they will eat readily twice daily (at about equal intervals) for about two weeks which is usually as long as fowls will stand up under such heavy feeding

Broilers may be held longer, especially if they are pen fattened They should then be fed grain in the litter at noon

In order that they will eat the new ration greedily, birds should not be fed for the first 24 hours after they are placed in the batteries or the pens

If at any time the birds go off feed one feeding should be



U S D A photograph by Knell

As chickens are received at the poultry-dressing plant, they are sorted, and those suitable for fattening are placed in fattening batteries. Each battery consists of 16 compartments or coops, 8 on a side, arranged in 4 tiers, one above another. The batteries are mounted on rollers so that they can be readily moved to the killing room as the birds become suitable for killing. The feeder pours a special fattening ration, consisting of ground grains mixed with buttermilk, into troughs fastened in front of each compartment in the battery.

omitted. Clean pails and troughs will help to prevent this condition.

Methods of fattening. Various methods are used, depending upon the purpose and conditions of fattening.

Stuffing or cramming. In this method, practiced largely in European countries, the birds are closely confined in small and usually darkened coops and are fed forcibly by hand or machine once or twice a day.

Battery fattening. This is the method used in the commercial fattening stations and on poultry farms in America. It is generally considered the best method for the production of gain, increase in fat, and grading of the dressed birds.

The birds are placed in small batteries or coops constructed of wire or slats with wire bottoms The feed troughs are suspended outside The capacity of the battery is determined by the number of birds that can eat from the trough at the same time A coop 3 feet square by 20 inches high will accommodate about 10 birds

Pen fattening In the case of pen fattening the birds are confined to a small coop with or without yards The birds are allowed more floor space than in battery fattening For best results, the flock should be limited to 20 or 30 birds They can be kept for a longer period of time than in batteries This method is often used for broilers or young stock

FATTENING RATIONS

Fattening rations are usually restricted and need not be as complete as rations for other purposes This is true because the birds are fed these rations for only a short time

Whole or cracked grain is fed only as a supplement in the case of pen fattening Grit, shell, charcoal, salt, and other accessory feeds are unnecessary Green food is usually not essential, although it is sometimes given as an appetizer Water is ordinarily not given as such, although in hot weather it may be necessary to give the birds water

The fattening ration is usually made up of a mash or ground feeds and mixed with liquid and is fed in the form of a thin or sloppy batter

Feeds A variety of feeds are used in fattening rations In general, they are fairly concentrated and usually finely ground Any of the ground cereals can be used as a base for the ration The ones commonly used are yellow corn, wheat, oats, and barley These grains influence the amount of fat deposited in the body in the order of corn, wheat, oats, and barley The yellow corn also produces a yellow-colored fat

Other feeds used are wheat middlings, low grade flour, oat meal oat flour, pea meal, barley meal, buckwheat middlings, buckwheat flour, graham flour, and hominy

Liquid buttermilk or skim milk as a moistener have been considered an essential ingredient in all good fattening rations

Fat or tallow is sometimes added to the ration in order to increase gains and fat and to produce a satisfactory flavor

TABLE 63 CORNELL RATIONS FOR FATTENING

RATION WITH LIQUID MILK

Feed	Pounds
Corn meal	50
Wheat flour middlings	20
Ground heavy oats	10

Mixed to a batter, fresh at each feeding, with buttermilk, or skim milk Will require approximately 2 pounds (1 quart) of milk to 1 pound (1 quart) of mash

RATION WITHOUT LIQUID MILK

Corn meal	50
Wheat flour middlings	20
Ground heavy oats	10
Dried skim milk or dried buttermilk	10
Meat scrap	10

Mixed to a batter, fresh at each feeding with water Will require approximately 3 pounds (1½ quarts) of water to 2 pounds (2 quarts) of mash

(G F Heuser *Poultry Rations*, Extension Bulletin 45 [Revised], Cornell University, Ithaca, New York, 1941)

Rations The ground grains are mixed with the liquid until the feed runs readily in hot weather and drips freely in cool weather It usually takes about 1 pound of dry feed and 2 pounds of buttermilk to produce a sloppy mixture

In the case of young birds the finishing process involves growth as well as plumping Hence, rations containing a larger amount of protein have given better feather growth and greater gains

Results and gains Increase in weight is one of the results of the fattening or finishing process The amount the birds will gain depends upon the age of the birds, the condition of the bird, the method of fattening, and the degree to which the various requirements are met In the case of growing birds, more economical gains are made during the earlier periods

Broilers show the greatest gains since they are still growing rapidly Gains of 24 to 38 per cent have been reported for broilers Results of fattening under the direction of the United States Department of Agriculture show an average gain for broilers of 32 3 per cent, requiring 3 75 pounds of feed to produce a pound of gain.

TABLE 64 FATTENING RATIONS (CANADA)

FEED	No 1	No 2	No 3	No 4	No 5	No 6	No 7
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Ground yellow corn	22 75	22 50	30 00	23 25	31 00	16 00	
Ground wheat	22 75	22 50		23 25			
Ground oats	22 75	22 50	30 00	23 25	31 00	30 00	31 00
Ground barley	22 75	22 50	30 00	23 25		30 00	31 00
Ground buckwheat					30 00		31 00
Rice feed [1]						16 00	
Beef meal	3 50	3 50	3 50	3 50	3 50	3 50	3 50
Powdered milk	2 50	2 50	2 50	2 50	2 50	2 50	2 50
Crude corn-oil	2 00	2 00	2 00				
Bone char or charcoal		1 00	1 00		1 00	1 00	
Salt	1 00	1 00	1 00	1 00	1 00	1 00	1 00
Total	100 00	100 00	100 00	100 00	100 00	100 00	100 00

Note The following suggestions are offered concerning the purpose for which each of the foregoing rations is intended

No 1 For commercial feeding on short periods—4 to 8 days—any class of stock.

No 2 For commercial feeding where white skin and fat finish is desired Add 1 per cent bone char or English nut charcoal to the ration

No 3 For pen feeding or range finishing of broilers Dry mash fed as desired in hoppers and two wet mash feedings per day, giving as much as will be cleaned up readily

No 4 For farm fattening (confinement in crates or pen feeding)—14-day feeding period

No 5 Recommended for heavy roasters and fowl where yellow fat and skin is not objectionable

No 6 Where rice feed is available, this ration should give excellent results with any class of stock

No 7 For heavy stock such as roasters and fowl especially Will produce a white finish

[1] Ground broken rice and polishings.

(Macdonald College Quebec, Canada)

TABLE 65 FATTENING RATION (TEXAS)

FEED	PER CENT
Finely ground yellow corn	34
Wheat gray shorts	20
Finely ground milo	20
Dried buttermilk	15
Finely ground oat groats	10
Salt	1

Mixed with water to the consistency of pancake batter

Roasters and hens do not make as large gains as younger birds Gains of 10 to 15 per cent have been reported The United States Department of Agriculture indicates an average gain of 12 1 per cent for roasters and 10 1 per cent for hens re

quiring respectively 5 22 and 4 97 pounds of feed per pound of gain

HORMONES IN POULTRY MEAT PRODUCTION

Hormones are substances secreted by the endocrine glands which include the thyroid and the ovary Some of them are extremely powerful The ovary produces substances known as estrogenic hormones The thyroid produces thyroxine The estrogenic hormones produce femaleness, certain characteristics of which are desired in table poultry Thyroxine affects the metabolic rate

Estrogenic hormones Recent experiments have shown that poultry can be fattened with synthetically prepared estrogenic hormones Some of the effects are an increased deposition of fat under the skin in the abdominal cavity, and in the muscles By the administration of these hormones to growing chickens capons or roosters the entire female behavior pattern has been produced Males cease crowing and sing like a laying hen The comb and wattles shrink and become pale The effect of these hormones may be likened to caponizing and they have been called feminizing agents Their use is also referred to as chemical caponizing There is a distinct effect on skin quality The skin becomes soft smooth velvety, and pliable The carcasses are better finished and more tender, making a superior market grade

The estrogenic hormones are of greatest use in fattening and finishing male fowls at any age They are useful for broilers of both sexes as these normally do not accumulate much fat The hormones can be used to fatten and tenderize old males Adult females are less likely to be improved, as most of them are supplied with their own natural estrogens

The hormones can be either injected, implanted under the skin as pellets or mixed with the feed The diethylstilbestrol pellet is now permitted by the Federal Food and Drug Administration Treatment for three to five weeks is adequate The pellets (15 to 20 milligrams in size) are slipped under the skin preferably high up in the neck where any unabsorbed remnants will be discarded

When mixed with feed the estrogens are not as effective as when injected Hence much larger quantities must be used For mixing in feed, dianisylhexene dianisylhexane and dien

estrol have proved very effective For fattening chickens, 40 milligrams of dianisylhexene in oil solution per pound of feed has proved very effective This produces the maximum response within two weeks' time It appears most useful for fattening broilers the last two or three weeks For turkey broilers, when fed for two or three weeks beginning when the birds are ten to eleven weeks old, there has been reported improvement in grade and feather development With older turkeys, two to four weeks' treatment is given when the birds are about five months old These synthetic hormones have not yet been permitted for mixing in feed by the Food and Drug Administration

Thyroid hormone. The feeding of thyroactive iodocasein has produced slightly heavier chicks and marked improvement in the amount of fat on the carcass Early and rapid feathering was also obtained It is necessary, however, to feed controlled amounts since growth is depressed and mortality increased as the levels of thyroxine are increased Ten to 20 grains per 100 pounds of feed are usually used

Thiouracil, which depresses the formation of thyroxine, has been reported as improving the fleshing and market grade of poultry When fed alone, growth is retarded It has shown some possibility when used in connection with the estrogenic hormones

SUGGESTIONS AND QUESTIONS

1 Visit fattening stations and broiler establishments

2 If possible, keep a record of a flock of broilers to get the following information average weights, feed required per pound of gain net return per bird, differences between rations and breeds

3 Keep a record for fattening birds Compute the gains, feed required and net returns

4 Observe the effects of caponizing or treatment with hormones

5 Note other kinds of market poultry, such as turkeys, ducks geese, pigeons, and game birds Visit farms producing any of these and obtain whatever records are available to make comparisons concerning feed required, weights, and net returns

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CHAPTER 12

Marketing Poultry Products

THE MARKETING SITUATION

UNTIL VERY recent years no other phase of the poultry industry was neglected to the same extent by the poultryman as the marketing of his product Since marketing of poultry products, particularly eggs, is a day to day or week to week, proposition, the poultryman was content to concentrate his energies on production and to dispose of his product in a manner that caused him the least inconvenience Since the majority of eggs in many sections of the country are produced by small flocks of 50 to 100 birds, the number of eggs to be marketed at any one time was small, and very often the eggs were taken to the grocery store or were picked up at the farm at irregular intervals by hucksters When live birds were sold, the same method of sale was common practice This method of sale often resulted in very low prices for products sold and therefore low returns on the poultry enterprise

When such products finally reached the consumer, they were often of poor quality and there was a tendency to build up consumer resistance rather than to cultivate a strong consumer demand Since the depression years of the early nineteen thirties, except for a period during World War II, the trend in modern poultry production and merchandising has been toward that type of poultry product with which consumers are seldom disappointed and for which buyers, purchasing for the retail trade, are willing to pay top or premium quotations, and which returns the highest prices to producers Market men say that such products practically sell themselves, for high quality builds

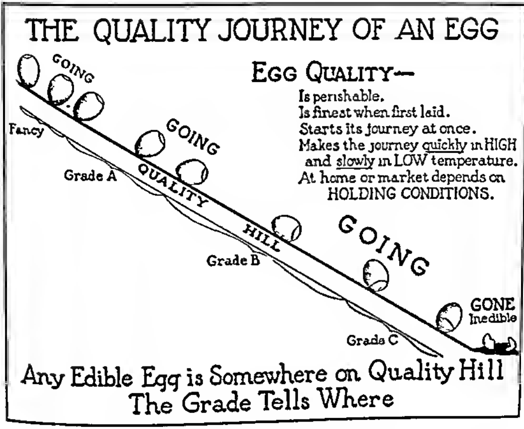
a desirable reputation The receiver has coming to his market the kinds of eggs and poultry he can sell easily and for high prices Buyers soon discover that a certain pack of eggs or brand of poultry runs uniform in size and quality, and ask for these packs by name or number

Marketing has been defined as the "act of selling or purchasing in or as in a market A bringing or sending to market" This definition does not adequately describe our modern system of marketing Reduced to simple terms, marketing consists of the performance, in orderly sequence, of a series of services By means of these services a product is moved from producer to consumer and presumably made available to the consumer at the time, the place, and in the form which best suits his convenience The hope of any program of marketing securing a better return for producers and giving consumers better value lies in the opportunities which may exist to eliminate nonessential marketing services, to improve the efficiency of essential services and occasionally to inaugurate new ones Technically, marketing includes all the business activity involved in getting goods and services to the consumer It is important to remember that the cornerstone of every productive industry is its market Destroy the market and you destroy the industry

The poultryman will be in a much better position to market his poultry products profitably if he has at hand market news and information By watching his local newspaper for market quotations or by listening to the radio valuable market information can be gained If the poultry enterprise is large, a good investment may be a subscription to a daily or weekly market report There are also many local, state, and national market reports sent free to poultrymen by the United States Department of Agriculture and by state departments of agriculture and markets

MARKETING EGGS

In connection with the marketing of eggs three facts face the poultryman (1) It is impossible in the light of present knowledge, to improve the interior quality or the size, shape, or color of eggs after they are laid (2) The only way to improve the quality of newly laid eggs is to start work on the problem before the eggs are formed that is to breed hens that will produce quality eggs (3) To reach the market with little or no deterio-



The quality journey of an egg.

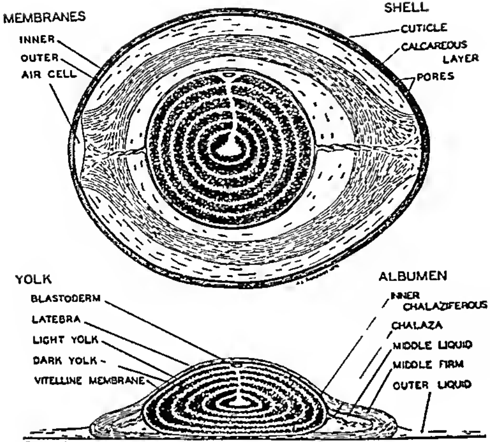
ration from the newly laid quality, eggs must be handled very carefully.

THE EGG

The egg is intended by nature to furnish a complete diet for a new life. It is, therefore, one of the most remarkably complete foods that man has appropriated for his own use. Produced under modern scientific methods, the egg of commerce is a palatable source of valuable food essentials. Its physical properties are part of the foundation of the art of cookery.

The egg consists of three main parts: the yolk, the albumen, or white, and the shell and its membranes. These are shown in the diagram on page 382.

The shell is primarily for protection. It forms a natural package, the consumer's assurance that the contents have not been adulterated. At the same time it hides the condition of the contents from the buyer and fails to warn of the highly perishable nature of the egg and the damage that may be done when it is handled improperly. The color of the shell is a



Courtesy Dr A L Romanoff

Diagrammatic cross-section of intact egg and of opened egg

hereditary character of the hen It is due to pigment laid on in the outermost layer of the shell after the egg is practically completed

The albumen, or white, is composed of four layers, two thin or watery and two firm or thick The proportions of these are given in Table 66 The innermost layer, very dense and fibrous, is tightly wound about the yolk and extended at either end of the egg, into the second firm layer in the form of tightly twisted strands of albumen fibers (ovo mucin) known as *chalazae* These serve the purpose of holding the yolk in the center of the egg and orienting the germ for incubation. They disintegrate slowly as the firm white breaks down

The inner thin albumen is contained in an envelope or sac of firm albumen It is not particularly important unless the firm

TABLE 66 THE RELATIVE PROPORTIONS OF THE DIFFERENT PARTS OF NORMAL NEW-LAID HENS' EGGS [1]

Percentage outer thin albumen of total albumen	22 14
Percentage outer thin albumen of total egg	12 93
Percentage thick albumen of total albumen	56 25
Percentage thick albumen of total egg	32 81
Percentage inner thin albumen of total albumen	21 73
Percentage inner thin albumen of total egg	12 65
Percentage total albumen of total egg	58 30
Percentage yolk of total egg	29 90
Percentage shell of total egg	11 79
Average egg weight	56 98 grams

[1] Observations made on 480 eggs.

envelope is ruptured and the inner thin allowed to mix with the outer thin to give the appearance of a very weak and watery egg The firm layer comprises from 50 to 65 per cent of the albumen of the egg, and upon its condition depends to a great extent the appearance of the egg when broken out, fried, or poached

The yolk is enclosed in the vitelline membrane which serves to support the yolk fluid and the germ, or blastoderm The germ, which appears as a small whitish spot on the surface of the yolk, is present in all eggs, whether or not fertile The germ of an infertile egg (and, fortunately, many market eggs are so produced today) will not develop when incubated whereas those which have been fertilized may

The hen's egg is made up of approximately 11 per cent shell, 58 per cent albumen, and 31 per cent yolk Specifically, it contains the ingredients shown in Table 67 Particularly impor

TABLE 67 COMPOSITION OF EGGS [1]

ITEM	YOLK	ALBUMEN	EDIBLE PORTION
Protein (per cent)	14–16	10–13	10–15
Fat (per cent)	30–35	Traces	9–14
Water (per cent)	46–52	80–88	70–76
Ash (per cent)	1 0–1 8	0 6–0 7	0 7–1 0
Calories (per lb)	1,645	230	670
Vitamins	Riboflavin [2]	Riboflavin [2]	ABDGE

Calcium, phosphorus, iron, copper and iodine are found in important quantities, as are many other minerals in less significant amounts

[1] Compiled from several sources not all in exact agreement.
[2] In all, eight of the B-complex vitamins have been found in the egg It is a good source of some and a poor source of others.

tant among these are the minerals and proteins which are in a form very easily used by the body Calcium, iron, phosphorus, and many other minerals are found, together with the vitamins A B D E, and riboflavin

WHAT IS QUALITY IN EGGS?

What is quality in eggs? Scientists are attempting to find the answer to this question Quality is defined as excellence of character, or natural superiority in kind As far as the poultryman is concerned in his marketing program, quality may be defined as that combination of characters in eggs which the consumer desires and for which he can and will pay More commonly the word quality is used to refer specifically to the accepted best condition, at a particular place Thus, to use a well known illustration with eggs, brown color of shell is an important character of quality in the Boston area, while chalk white shell is important on the New York City market Actually, neither character has any relation to the quality of the contents Many of the so-called quality characters for eggs have no nutritional value, but they are characters that consumers (buyers) have learned to desire and for which they are willing to pay

The characters that are considered today in the determination or measurement of egg quality may be classified under two headings those that are readily apparent or *external* characters, and those that are hidden within the shell or *internal* characters

Exterior quality The external characters are shell color, shape condition and size *Shell color* has already been mentioned In certain markets it is of considerable economic significance Since uniform shell color is a matter of breeding and careful breeding is usually accompanied by care in production and marketing there are market preferences for either white or brown shells as contrasted with mixed colors or spotted and varicolored eggs The exact preference at any particular market appears to depend upon custom growing out of experience with eggs from the predominant breeds of the locality

The common breeds of chicken kept for commercial egg production lay eggs of some shades of brown or white The

Araucana, a bird from South America, lays a blue egg Breeds of the Mediterranean class, such as Leghorns, Anconas, and Minorcas, should lay pure white eggs Breeds of the American and Asiatic classes—Plymouth Rocks Rhode Island Reds, New Hampshires, and Brahmas—lay brown eggs In these breeds a uniform, medium brown color is desired In the brown egg breeds the shade of brown color usually decreases in intensity with advancing production Tinted eggs of the white egg birds may become pure white after a few months of production Crosses of dark brown by white varieties are likely to produce eggs ranging in the medium brown shades

Shape is important in packing and shipping, but, provided reasonable uniformity is found in the package, the consumer does not pay a great deal of attention to this character

Shell condition usually refers to cleanliness and soundness It goes without saying that a clean egg presents the more desirable appearance and impression upon the buyer Unsound eggs eliminate themselves to a large extent, but frequently not without soiling others that are near them As with dirty eggs, weak or checked shells create a very poor impression even though they are not actually a loss when the buyer gets them

The most important factor of shell quality is thickness Thick shells are desirable both for market eggs and for hatching eggs A number of investigators have presented evidence showing a breed variation in amount and thickness of shell

The most important character concerned in the quality of market eggs is that of *size* The size of eggs is measured in commercial practice exclusively by weighing Table 68 gives the most generally accepted standards in weight per egg per dozen and per case (30 dozen) This character is controlled very largely by two conditions in the bird, namely size of bird and heredity The direct connection between body size and egg size within a breed or strain, has long been known That temperature has a slight effect on egg size has often been demonstrated

The discrimination against small eggs in the market is sufficient to encourage the production of large eggs The selection for too large egg size is undesirable, however Eggs weighing more than 30 ounces per dozen are too large for the standard

TABLE 68. UNITED STATES WEIGHT CLASSES FOR CONSUMER GRADES FOR SHELL EGGS

Size or Weight Class	Minimum Net Weight per Dozen	Minimum Net Weight per 30 Dozen	Minimum Weight for Individual Eggs at Rate per Dozen [1]
	Ounces	*Pounds*	*Ounces*
Jumbo	30	56	29
Extra large	27	50½	26
Large	24	45	23
Medium	21	39½	20
Small	18	34	17
Peewee	15	28	

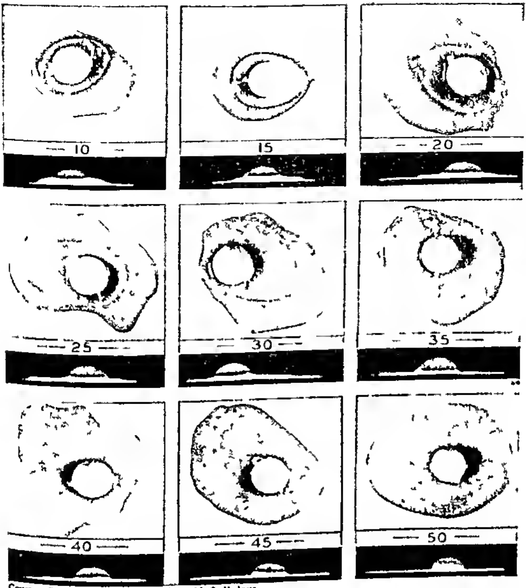
[1] Minimum weights listed for individual eggs at the rate per dozen are permitted in various size classes only to the extent that they will not reduce the net weight per dozen below the required minimum, consideration being given to variable weight of individual eggs and variable efficiency of graders and scales which should be maintained on a uniform and accurate basis.

types of fillers and cases used for chicken eggs. When premium prices can be obtained for "jumbo" sizes some poultrymen may be justified in producing these oversize eggs.

Careful selection of breeding stock for large egg size will result in control of this character.

Interior quality. Internal characters may be divided according to whether they involve the yolk or the albumen. Yolk characters are color, condition, and germ development. The albumen is classified according to its consistency and condition and the proportion of the various layers. The score of the observed condition of the firm albumen has been demonstrated to be a characteristic of the individual and is influenced by heredity factors. The same may be said of the proportion of thick white. The method of inheritance is complex. Neither of these characters seems to be affected to any degree by the food which the hen consumes. Abnormal occurrences, such as meat spots and blood spots, are recognized of course, and may, if large or objectionable, overshadow all other considerations. Food value and flavor are important considerations in gaining consumer acceptance, but unfortunately neither of these can be readily determined before the egg is sold or, in many cases, even before it is used.

Yolk color is one of the most debated characters of egg quality. It is almost entirely dependent upon the feed eaten by the bird and can be influenced easily by controlling the pigment in the diet. Dark yolk color is usually associated with green feeds and large porportions of yellow corn or other highly



Courtesy Dr A Van Wagenen and Dr H S Wilgus

Photographic standards for the condition of the firm albumen. The albumen is scored, ranging from 1.0, in which the firm albumen envelope stands up well around the yolk and retains the egg shape, to score 5.0, in which no firm albumen is discernible. These photographs were all taken of new-laid eggs, but the score can be applied to all eggs, regardless of age, provided the vitelline membrane of the yolk is unruptured.

pigmented foods in the diet. It is not necessarily an indication of higher vitamin content. The control of the darker shades of yolk color is more difficult than of the lighter, hence there is less variation in yolk color from those birds fed to produce the lighter shades. Most consumers apparently do not understand the differences in yolk color and thus prefer eggs with

uniformly colored yolks, the particular shade being of lesser importance. On the market the lighter shades are preferred, and paid for, since the color does have some influence on the candled appearance of the egg, and these eggs have been found to have greater uniformity in actual yolk color when broken out for use.

The shape of the yolk is included in describing its condition, as well as the appearance of such things as darkened areas or mottling. The shape depends greatly upon the strength of the supporting structures, including the vitelline membrane and albumen. Deterioration of the egg involves a weakening of this structure and some dilution of the yolk contents by the passage of water to it.

Mottled yolks is the name given to those yolks on the surface of which appear areas darker in color than the majority of the surface. They are more common in the poorer qualities. At first they were believed to be spots beneath the membrane in which either the oils of the yolk fluid had accumulated or into which water had passed from the albumen. They can be readily produced by rubbing the surface of the yolk with a smooth implement. Many instances can be explained by referring to the manner in which the yolk fluid is laid down in alternate layers of light and dark material. If the outside layer is of light fluid, it may be thin in spots and permit the darker layer beneath to show through as mottling. This is occasionally found in newly laid yolks.

NUTRITIONAL VALUE OF EGGS

The egg is classed as a "protective" food along with milk, fruits, and vegetables. It is especially rich in proteins of high quality, vitamins and minerals. The yolk being high in fat, it is an excellent source of energy. Since they contain most of the substances required for an adequate diet, eggs are particularly valuable as a supplement to other foods which may be lacking in some one or more vital substances.

FACTORS AFFECTING EGG QUALITY BEFORE THE EGG IS LAID

In discussing the various egg-quality factors it has been ...ted out that heredity plays a very important role in de-

termining certain egg characters at the time the egg is laid and that wide variation in these characters may exist in new laid eggs from different hens It is impossible to improve the original quality which an egg possesses at the time it is deposited in the nest or in the battery That a part of the variation in new laid quality may be due to feed and management has also been suggested

By far the greater amount of variation, usually encountered in commercial eggs on the market, occurs because of conditions affecting the egg after it is laid

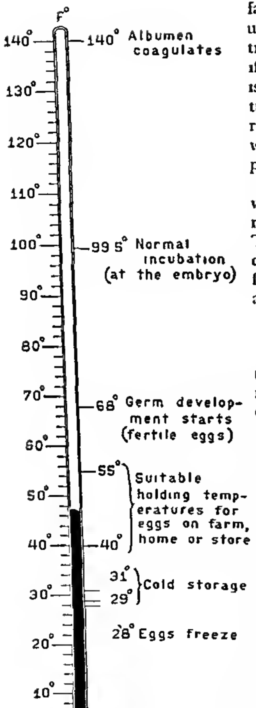
FACTORS AFFECTING EGG QUALITY AFTER THE EGG IS LAID

Time is an important factor affecting egg quality Other conditions being constant the quality of an egg is closely related to its age Demonstrations have shown however, that deterioration is somewhat more rapid during the first few days eggs are held, after which the amount of deterioration per unit of time decreases Eggs of varying quality stand up under storage conditions in proportion to their original quality, although the percentage loss may be approximately the same

Temperature is without doubt the most important factor affecting egg quality The diagram on page 390 shows a few of the more critical temperatures in the life of an egg Because of the high body temperature of the hen an egg at the time of laying has a temperature of more than 100° F Deterioration begins at once This fact emphasizes the importance of gathering eggs often and cooling them as quickly as possible

In the normal marketing procedure where eggs are held by the farmer, wholesaler, jobber, or retailer for short periods of time, temperatures ranging from 40° F to 55° F appear to be satisfactory The consumer should keep eggs in the household refrigerator as he does other perishable products The egg container should be covered Eggs show more deterioration in 3 days at 100° F than they do in 100 days at 30° F

The effect of humidity on egg quality is to control the evaporation of moisture from the egg contents Since loss by evaporation is measured by the increase in the size of the air cell and since in market channels this is an important egg quality



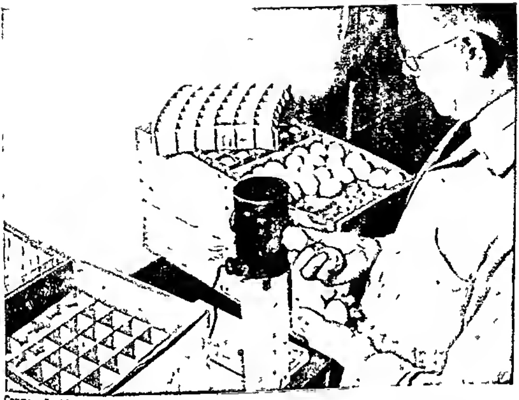
Critical temperatures in the life of an egg

factor, the eggs should be held under conditions of high relative humidity It is doubtful if the actual quality of the egg is affected adversely by moisture levels as low as 60 per cent relative humidity, particularly when eggs are held for short periods

That eggs readily asorb flavors and odors from their surroundings has been shown They should be kept in a clean, sanitary environment, free from objectionable odors, at all times

DETERMINING QUALITY

Candling, as a means of determining egg quality, is not new History relates throughout its pages, from the time of the early Egyptians and Chinese to present-day marketing procedures, the use of a beam of light in the separation of various qualities of eggs Candling is essentially a study of light and shadows The egg is held before an opening in a shield so that a beam of light penetrates and illuminates it The observer then interprets what he sees in terms of how this egg differs from a normal new laid egg and how it will appear when broken out of the shell for use Many candlers have found the practice of occasionally breaking out an egg



Courtesy L. M. Hurd

Candling eggs. Where the producer sells his eggs at retail it is a good practice to remove abnormal eggs, particularly eggs containing blood spots or meat spots.

that has been candled to compare it with broken-out standards (such as those shown on page 403) invaluable in keeping their mental standards constant.

In actual practice, the contents of the egg are given a twirling motion with the fingers just as the egg is held up to the light. Thus the entire contents of the egg are brought before the eye for the discovery of defects. At the same time the manner in which the yolk floats within the albumen can be observed.

This discussion does not go into complete detail regarding the various descriptions of the yolk outline, yolk centering, albumen condition, air-cell condition, and abnormalities that go to make up the language of grades and standards. These vary to some extent among the various official agencies propounding them and are changed from time to time as research workers find new facts and commerce learns to apply these facts to trading. Candling is not an exact science but rather

an art in which proficiency is gained by practice and study It is the best in fact the only commercially practical, method of grading shell eggs at present available The use of electronics in quality determinations is now in the experimental stage

The observations to be made in candling depend to a degree upon the purpose for which the eggs are being candled Producers usually candle, if at all, only to remove abnormal eggs, such as those with blood spots and meat spots, and to detect the weak and cracked shells In some states retailers are required by law to candle and grade all eggs sold or to purchase only graded eggs The retailer is responsible for the quality of eggs sold to consumers

The parts of the egg usually observed in candling are the shell, the air cell, the yolk outline and yolk centering (indicating both yolk and albumen condition), and the presence or absence of germ development and abnormalities

GRADING EGGS

Eggs are produced on more than 85 per cent of the almost seven million farms in all parts of the United States No other farm product is so universally produced and few are as generally consumed The necessity for standardized grades in the merchandising of a perishable food that is produced and handled under such widely varying conditions need not be discussed here

Factors of quality used in grading eggs *Air cell* A large air cell indicates excessive age or a high temperature and low humidity in the holding room

Yolk A well defined yolk outline or a yolk not well centered indicates a watery white, excessive age, or poor holding conditions A very dark yolk shadow may indicate heavy feeding of green feed

White Watery white indicates excessive age high temperature in the holding room or the presence of low-quality producers in a flock

Shell Dirty eggs Cracked shell Thin shelled eggs are the result of extremely high production over a long period after effects of severe colds or other diseases lack of calcium assimilation because of insufficient calcium in the ration or insufficient

Students candling eggs in an egg-grading laboratory.

vitamin D in the ration Individual hens sometimes produce only soft-shelled eggs.

Abnormalities. Blood rings—germ development. Blood spots, bloody eggs, and meat spots—hemorrhage during yolk formation. Individual hens may have a tendency to produce abnormal eggs.

There are some factors of quality which cannot be determined by candling In general, fresh eggs do not have unpalatable flavors and odors Foreign odors and flavors are sometimes present in eggs, however. These flavors may result from the exposure of eggs to excessive dampness, musty, poorly ventilated cellars; exposure of eggs to materials having strong odors, such as cod-liver oil, vegetables, kerosene, and certain disinfectants. Feeding excessive amounts of strongly flavored green foods, as onions and rape, may produce off flavor in eggs. Some individual hens lay eggs with strong odors or flavors.

Standards and grades. The Bureau of Agricultural Economics, United States Department of Agriculture, has proposed standards and grades for eggs from time to time. Many revisions have been made since the first standards and grades were promulgated. For many years a uniform grading system using

government standards and grades for eggs has been advocated by the United States Department of Agriculture and other agencies. The industry has been slow to adopt these grades because the larger handlers of eggs have their own private trade names and established brands which might have to be changed or eliminated if government grades were to be adopted.

The term *standards* applies to individual eggs only and sets forth the quality specifications which must be met in each of the standards for quality established. Since the standards for quality apply to individual eggs, there are no tolerances.

The latest order of promulgation of standards became effective December 1, 1946, and was as follows:

SPECIFICATIONS FOR OFFICIAL UNITED STATES STANDARDS FOR QUALITY OF INDIVIDUAL SHELL EGGS

U. S. Standards for Quality of Individual Eggs with Clean Unbroken Shells [1]

1. AA Quality. The shell must be clean, unbroken, and practically normal. The air cell must not exceed 1/8 inch in depth and be practically regular. The white must be clear and firm so that the yolk appears well centered and its outline only slightly defined when the egg is twirled before the candling light. The yolk must be free from apparent defects

2. A Quality. The shell must be clean, unbroken, and practically normal. The air cell must not exceed 2/8 inch in depth and must be practically regular. The white must be clear and at least reasonably firm so that the yolk appears at least fairly well centered and its outline only fairly well defined when the egg is twirled before the candling light. The yolk must be practically free from apparent defects.

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[1] Interior egg quality specifications for the Official Standards for Quality of Individual Shell Eggs are based on the use of a candling light delivering approximately 350 to 450 foot candles of light at the candling opening The usual box type of candling light, without reflector, using a clean 40 watt frosted bulb about 1½ inches from and in direct line (direct light) behind the opening which should be approximately 1¼ inches in diameter or a clean 60 watt frosted bulb immediately above and 1½ inches behind the opening (indirect light), provides approximately 310 foot candles of light at the opening A 60 watt bulb in a direct light candler or a 75 watt bulb in an indirect light candler provides approximately 380 foot candles of light at the opening

Reference to "usual box type of candling light" should not be construed as restricting use to that type only Any type or make of candler may be used so long as the resulting light is the same.

3. B Quality. The shell must be clean, unbroken, and may be slightly abnormal. The air cell must not exceed 3/8 inch in depth and may show total movement not in excess of 3/8 inch. However, an air cell not over 3/8 inch in depth may be free. The white must be clear but may be slightly weak so that the yolk may appear off center with its outline well defined when the egg is twirled before the candling light. The yolk may appear slightly enlarged and slightly flattened and may show other definite but not serious defects.

4. C Quality. The shell must be clean, unbroken, and may be abnormal. The air cell may be over 3/8 inch in depth and may be bubbly or free. The white may be weak and watery so that the yolk may appear off center and its outline plainly visible when the egg is twirled before the candling light. The yolk may appear dark, enlarged, and flattened, and may show clearly visible germ development but no blood due to such development. It may show other serious defects that do not render the egg inedible. Small blood clots or spots may be present.

U. S. Standards for Quality of Individual Eggs with Dirty Unbroken Shells

5. Stained. Individual egg that has no adhering dirt and no more than a combined total of 1/8 of the shell surface stained or soiled.

6. Dirty. Individual egg that has adhering dirt or more than a combined total of 1/8 of the shell surface stained or soiled.

U. S. Standards for Quality of Individual Eggs with Checked or Cracked Shells

7. Check. Individual egg that has a broken shell or crack in the shell but with no leakage of the contents.

8. Leaker. Individual egg that has a broken shell or crack in the shell and shell membranes with the contents exuding or free to exude through the shell.

EXPLANATION OF TERMS

9. The Official United States Standards for Quality of Individual Shell Eggs are applicable to eggs that are the product of the domesticated chicken hen and are in the shell.

Terms Descriptive of the Shell

10. Clean. A shell that is free from foreign matter and from stains or discolorations that are readily visible. Eggs with only very small specks or stains may be considered clean, if such eggs are not of sufficient number in a package to detract appreciably from its

appearance. Eggs that show traces of processing oil on the shell are considered clean unless the shell is otherwise soiled.

11. Stained. A shell with stained or soiled spots that together cover not more than 1/8 of the shell surface but without adhering dirt.

12. Dirty. A shell with adhering dirt or with stained or soiled spots that together cover more than 1/8 of the shell surface.

13. Unbroken. A shell that is free from checks or breaks.

14. Checked or cracked. A shell that has an actual break but its membranes are unbroken and its contents do not leak.

15. Leaker. A leaker is an egg in which the shell and shell membranes are broken to the extent that the egg contents are exuding or free to exude through the shell.

16. Practically normal (AA, A). A shell that approximates the usual shape and that is of good even texture and strength and free from rough areas or thin spots. Slight ridges and rough areas that do not materially affect the shape, texture, and strength of the shell are permitted.

17. Slightly abnormal (B). A shell that may be somewhat unusual in shape or that may be slightly faulty in texture or strength. It may show definite ridges but no pronounced thin spots or rough areas.

18. Abnormal (C). A shell that may be decidedly misshapen or faulty in texture or strength or that may show pronounced ridges, thin spots, or rough areas.

Terms Descriptive of the Air Cell

19. Depth of air cell (air space between shell membranes, normally in the large end of the egg). The depth of the air cell is the distance from its top to its bottom when the egg is held air cell upward.

20. Practically regular (AA, A). An air cell that maintains a practically fixed position in the egg and shows a fairly even outline, with no more than 1/8-inch movement in any direction as the egg is rotated.

21. Movement not in excess of 3/8 inch (B). An air cell that shows a total movement not in excess of 3/8 inch in any direction as the egg is rotated.

22. Free air cell (B, C). An air cell that moves freely toward the uppermost point in the egg as the egg is rotated slowly.

23. Bubbly air cell (C). A ruptured air cell resulting in one or more small separate air bubbles usually floating beneath the main air cell.

Terms Descriptive of the White

21 Clear (AA, A, B). A white that is free from discoloration or from any foreign bodies floating in it (Prominent chalazas should not be confused with foreign bodies such as spots or blood clots)

25 Firm (AA). A white that is sufficiently thick or viscous to permit but limited movement of the yolk from the center of the egg, thus preventing the yolk outline from being more than slightly defined or indistinctly indicated when the egg is twirled

26. Reasonably firm (A) A white that is somewhat less thick or viscous than a firm white A reasonably firm white permits the yolk to move somewhat more freely from its normal position in the center of the egg and approach the shell more closely This would result in a fairly well defined yolk outline when the egg is twirled

27 Slightly weak (B) A white that is lacking in thickness or viscosity to an extent that permits the yolk to move quite freely from its normal position in the center of the egg A slightly weak white will cause the yolk outline to appear well defined when the egg is twirled

28. Weak and watery (C). A white that is thin and generally lacking in viscosity A weak and watery white permits the yolk to move freely from the center of the egg and to approach the shell closely, thus causing the yolk outline to appear plainly visible and dark when the egg is twirled

29 Blood clots and spots (not due to germ development). Blood clots or spots on the surface of the yolk or floating in the white These blood clots may have lost their characteristic red color and appear as small spots or foreign material commonly referred to as meat spots Such blood clots or spots are incorporated in the egg during its formation or after the yolk leaves the ovary If they are small (not over ⅛ inch in diameter) the egg may be classed as C quality If larger and/or showing diffusion of blood in the white surrounding them, the egg shall be classified as loss

30 Bloody white (loss). An egg, the white of which has blood diffused through it Such a condition may be present in new laid eggs Eggs with bloody whites are classed as loss

Terms Descriptive of the Yolk

31 Well centered (AA). A yolk that occupies the center of the egg and moves only slightly from that position as the egg is twirled

32 Fairly well centered (A) A yolk that is not more than one fourth of the distance from its normal central position toward the ends of the egg and swings not more than one half of the distance

from its normal position towards the sides of the egg as it is twirled.

33. Off center (B, C). A yolk which is distinctly above or below center and swings close to the sides of the egg as it is twirled.

34. Outline slightly defined (AA). A yolk outline that is indistinctly indicated and appears to blend into the surrounding white as the egg is twirled.

35. Outline fairly well defined (A). A yolk outline that is discernible but not clearly outlined as the egg is twirled.

36. Outline well defined (B). A yolk outline that is quite definite and distinct as the egg is twirled.

37. Outline plainly visible (C). A yolk outline that is clearly visible as a dark shadow when the egg is twirled.

38. Slightly enlarged and slightly flattened (B). A yolk in which the yolk membranes and tissues have weakened somewhat, causing it to appear slightly enlarged and slightly flattened.

39. Enlarged and flattened (C). A yolk in which the yolk membranes and tissues have weakened and moisture has been absorbed from the white to such an extent that it appears definitely enlarged and flat.

40. Free from defects (AA). A yolk that shows no spots or areas on its surface indicating the presence of germ development or other defects.

41. Practically free from defects (A). A yolk that shows no germ development but may show other very slight defects on its surface.

42. Definite but not serious defects (B). A yolk that may show definite spots or areas on its surface but with only slight indication of germ development or other pronounced or serious defects.

43. Other serious defects (C). A yolk that shows well developed spots or areas and other serious defects, such as olive yolks, which do not render the egg inedible.

44. Clearly visible germ development (C). A development of the germ spot on the yolk of a fertile egg that has progressed to a point where it is plainly visible as a definite circular area or spot with no blood in evidence.

45. Blood due to germ development (inedible). Blood caused by development of the germ in a fertile egg to the point where it is visible as definite lines or blood ring. Such eggs are classified as inedible.

46. Loss. Eggs that are inedible, smashed, broken so that contents are leaking, contaminated, or containing bloody whites, large blood spots, large unsightly meat spots, or other foreign material are classed as "Loss."

47. Inedible eggs. Under the Food, Drug, and Cosmetic Act, eggs that are filthy, putrid, or decomposed, or otherwise unfit for

Summary of United States Standards for Quality of Individual Shell Eggs

(Figures in parentheses refer to paragraph number of Explanation of Terms on pages 395 to 398)

Quality Factor	Specifications for Each Quality Factor							
	AA Quality	A Quality	B Quality	C Quality	Stained	Dirty	Check	Leaker
Shell	Clean (10), unbroken (13), practically normal (16)	Clean (10), unbroken (13), practically normal (16)	Clean (10), unbroken (13), may be slightly abnormal (17)	Clean (10), unbroken (13), may be abnormal (18)	Unbroken (13), may be stained or soiled (11)	Unbroken (13), may be dirty (12)	Checked or cracked but not leaking (14)	Broken so contents are leaking (15)
Air cell	1/8 inch or less in depth (19), practically regular (20)	3/16 inch or less in depth (19), practically regular (20)	3/8 inch or less in depth (19), may show movement not over 3/8 inch (21), if not over 3/8 inch may be free (22)	May be over 3/8 inch in depth (19), may be free or bubbly (22, 23)				
White	Clear (24), firm (25)	Clear (24) may be reasonably firm (26)	Clear (24), may be slightly weak (27)	Clear (24), may be weak and watery (28), small blood clots or spots may be present (29)				
Yolk	Well centered (31), outline slightly defined (34), free from defects (40)	May be fairly well centered (32), outline may be fairly well defined (35), practically free from defects (41)	May be off center (33), outline may be well defined (36), may be slightly enlarged and flattened (38), definite but not serious defects (42)	May be off center (33), outline may be plainly visible (37), may be enlarged and flattened (39), may show clearly visible germ development but no blood (44), may show other serious defects (43)				

food in whole or in part, are adulterated Eggs of the following descriptions are classed as inedible black rots white rots, mixed rots (addled eggs), sour eggs, eggs with green whites, eggs with stuck yolks, moldy eggs, musty eggs, eggs showing blood rings, eggs containing embryo chicks (at or beyond the blood ring stage), and any other eggs that are filthy, decomposed, or putrid

The term *grade* applies to variations in quality measured in terms of the standards for quality of individual eggs Grades not only apply to individual eggs but to eggs in dozen lots, case lots, or in carloads

The Department of Agriculture on December 1, 1947, established the following *tentative U S specifications* and weight classes for consumer grades of shell eggs

U S Consumer Grade AA Shall consist of edible eggs of which at least 80 per cent[1] are AA Quality, 15 per cent[1] may be A Quality, and not over 5 per cent[1] may be of the qualities below A, in any combination, but not including Dirties[2]

U S Consumer Grade A Shall consist of edible eggs of which at least 80 per cent[1] are A Quality or better, 15 per cent[1] may be B Quality, and not over 5 per cent[1] may be of the qualities below B, in any combination, but not including Dirties[2,3]

U S Consumer Grade B Shall consist of edible eggs of which at least 80 per cent[1] are B Quality or better, 10 per cent[1] may be C Quality or Stained, in any combination, and not over 10 per cent[1] may be Dirties or Checks in any combination[2,3]

U S Consumer Grade C Shall consist of edible eggs of which at least 80 per cent[1] are C Quality or Stained in any combination, or better, and the balance may be Dirties or Checks in any combination[2]

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[1] Officially graded eggs shall *conform as nearly as possible to the specifications* of the respective standards of quality Tolerances (a total of 20 per cent) are permitted within each grade only as an allowance for variable efficiency and interpretation of conscientious graders normal changes under favorable conditions during reasonable period between grading and inspection and reasonable variation from inspector's interpretation *Substitution of higher qualities for those* specified is permitted

[2] Within the total tolerance permitted an allowance will be made at receiving points or shipping destination for ½ per cent leakers in Grades AA A and B and 1 per cent in Grade C

[3] Eggs with stained shells but otherwise *conforming to the specifications* of Grade A or Grade B may be classified as Grade A Stained or Grade B Stained respectively

Weight Classes for Consumer Grades for Shell Eggs

Size or Weight Class	Minimum Net Weight per Dozen	Minimum Net Weight per 30 Dozen	Minimum Weight for Individual Eggs at Rate per Dozen [1]
	Ounces	*Pounds*	*Ounces*
Jumbo	30	56	29
Extra Large	27	50½	26
Large	24	45	23
Medium	21	39½	20
Small	18	34	17
Peewee	15	28	

[1] Minimum weights listed for individual eggs at the rate per dozen are permitted in various size classes only to the extent that they will not reduce the net weight per dozen below the required minimum, consideration being given to variable weight of individual eggs and variable efficiency of graders and scales which should be maintained on a uniform and accurate basis

Summary of Specifications for U S Consumer Grades for Shell Eggs

U S Consumer Grade	At Least 80 Per Cent (Lot Average) [1] Must Be—	Tolerance Permitted [2]	
		Per Cent	Quality
U S Grade AA	AA Quality	15 to 20, not over 5 [3]	A B, C, Stained, or Check
U S. Grade A	A Quality or better	15 to 20, not over 5 [3]	B C, Stained, or Check
U S Grade B	B Quality or better	10 to 20, not over 10 [3]	C, or Stained, Dirty or Check
U S Grade C	C Quality or better	Not over 20	Dirty or Check

[1] In lots of more than 30 cases no individual case may fall below 70 per cent of the specified quality and in lots of 30 cases or less the 80 per cent minimum requirement shall apply to each individual case

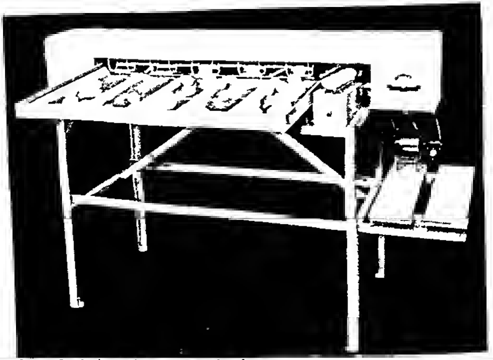
[2] Within tolerance permitted, an allowance will be made at receiving points or shipping destination for ½ per cent leakers in Grades AA, A and B, and 1 per cent in Grade C.

[3] Substitution of higher qualities for the lower qualities specified is permitted

No Grade. Eggs of possible edible quality that fail to meet the requirements of an Official or Tentative U. S Grade or that have been contaminated by smoke, chemicals, or other foreign material that has seriously affected the character, appearance, or flavor of the eggs are classed as "No Grade."

There is a great deal of confusion in the grading of eggs. Many large packing organizations, co operatives, and exchanges, as well as retail organizations have their own grades. Often the terms used in describing the eggs for sale give the consumer but little if any idea of the quality he may expect.

A study of the price quotations on eggs in the central markets shows that each market has a different set of grades. The adop-



Courtesy Otto Niederer and Sons Titusville New Jersey

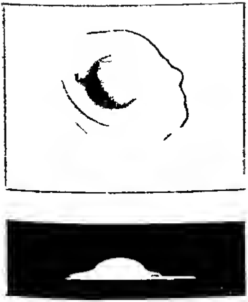
An egg grader saves time and insures accuracy This grader sorts eggs into five sizes

tion of a uniform system for grading eggs would be of great benefit to the industry

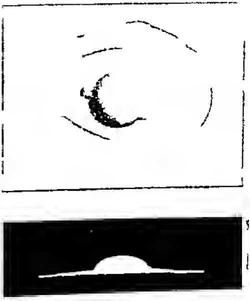
MAINTAINING QUALITY

In general the quality of newly laid eggs is good and that quality may be maintained at its best by proper feeding breeding and management methods The following program will go far toward maintaining quality in market eggs

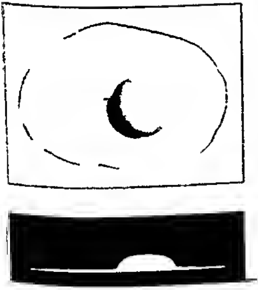
I Breed for size shape color of shell and firm white
  A Select chicks from hens known to produce quality eggs
II Produce strong shells and moderately colored yolks
  A Feed a ration known to contain a plentiful supply of vitamin D
  B Provide a high-quality oystershell in several feeders in each pen
  C Confine layers to the laying house and feed only limited amounts of green feed



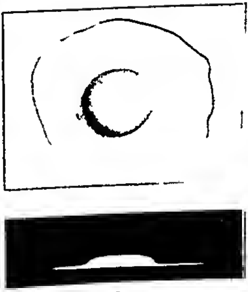
FANCY



A



B



C

The appearance of eggs of average quality in each of the four New York State Retail Grades of eggs. The specifications for these four grades correspond very closely to the four United States Consumer grades of eggs, AA, A, B, and C

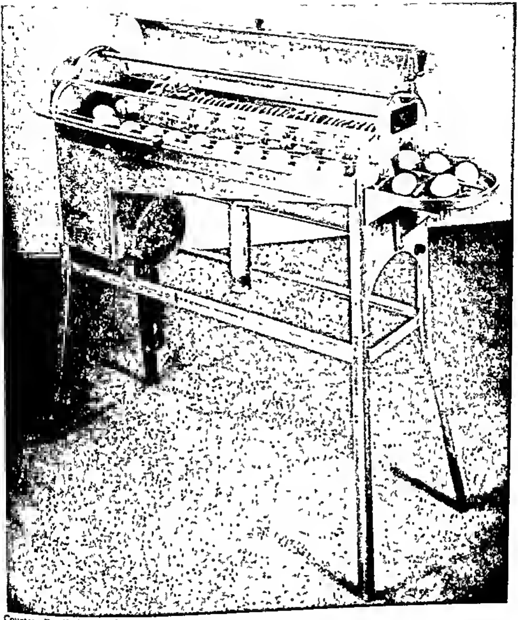
III Produce clean infertile eggs
  A Use clean nesting material and allow sufficient nests to prevent crowding or one nest for five or six hens
  B Screen the dropping boards

Eggs cool much more rapidly in open wire baskets than in metal pails or other tight containers.

C. Keep the litter reasonably clean and dry and at least 2 inches deep over the entire floor.
D. Allow at least 3 square feet of floor space per bird.
E. Remove males promptly after breeding season.
F. Remove and break up broody hens promptly.

IV. Keep eggs cool.
A. Gather eggs at least three times daily and collect them in wire baskets to allow air circulation and rapid egg cooling.
B. Place eggs in a clean cellar or room immediately.
C. Keep egg room well ventilated but without cross drafts and at a temperature between 35° F. and 55° F.
D. Keep egg room fairly moist (70 per cent relative humidity or higher).
E. Do not pack in cases until the eggs are thoroughly cooled. The cases, flats, and fillers should also be held in the egg room for several days before the eggs are packed in them.

V. Sort eggs for size, color and interior quality.
A. Candle eggs if they are to be sold retail, or if they will



Courtesy Dr. F. B. Wright

The Wright egg washer. Eggs are exposed to hot water, 170° or more, for a period of 22 seconds under the action of rotating abrasive cloth disks. The eggs are dried at the front of the machine by warm air from an electric heater. Capacity is three to five cases an hour.

not be candled later by other agencies handling the eggs, to remove blood spots, cracked, low-quality, or inedible eggs.

B. Sort for size.
C. Separate brown and tinted eggs from white eggs.
D. Clean all soiled eggs.

VI. Pack each size and color separately in strong, clean cases with sound, clean flats and fillers.

   A. Pack white, brown, and tinted eggs separately, and identify on the case.
   B. Always pack with the small end down.
   C. If extra long or very large eggs are shipped, pack at the center of the top fillers and build up the case ends $\frac{1}{4}$ inch or more.
   D. Do not use damp, dirty, or musty fillers, as eggs will absorb the odor and are then inedible.
   E. Nail a one-piece cover at the ends with four nails each. (Never nail to center partition.)

VII. Ship not less than twice weekly.

   A. Select a means of transportation that gives:
      1. Protection from high or low temperature.
      2. Minimum and careful handling of eggs.
      3. Prompt delivery to destination.

Thermostabilization, a process of heat-treating eggs that was developed during World War II, may be of considerable importance in the future in the maintenance of quality. It may have a tendency to decrease the advantage of the eastern producer because of his nearness to market. This method of quality control has not been used extensively, but under certain conditions it may develop rapidly.

The technological developments in egg washers may soon result in a marked reduction in the number of dirty eggs moving to market. It is still best to produce clean eggs, but when the producer's best efforts still result in some dirty eggs, the washer may save time and perhaps increase returns. A commercial egg washer is shown on page 405.

CONTAINERS USED FOR EGGS

Eggs for market are usually packed in cartons holding one-half dozen or one dozen, in cardboard or fiber boxes holding 15 or 20 dozen, or in the standard wooden case holding 30 dozen.

Eggs are usually retailed in cartons or as loose eggs in paper bags. Cartons holding one dozen eggs are made in two styles, one for three rows of four eggs, and one for two rows of six

eggs each Sometimes the latter kind is made so that it can be divided in the middle to allow selling one half dozen eggs at a time The carton for two rows of six eggs each fits into the standard 30-dozen case This method is used extensively for delivering eggs short distances and especially from warehouses to retail stores This carton also lends itself to the use of automatic machinery in setting it up as well as closing and sealing after it has been filled

Parcel post and express containers are made in various styles and sizes Some are pasteboard and others are made of fiber or light metal They hold from two to several dozen eggs They are used by producers to send eggs directly to consumers in cities The containers may be used once, or they may be returned and used many times They should be strong yet light in weight so as not to add much to the total shipping costs

The standard egg case, with a capacity of 30 dozen, has a solid partition in the center so that each half of the case holds 15 dozen eggs Cottonwood and spruce are two of the most popular woods used in the manufacture of egg cases The cases are light and durable, convenient to handle, and because of their light weight do not add much to the total shipping costs

The packing material used in the 30-dozen egg case includes fillers and flats, or the filler flat These cases are available in a number of styles and designs, including the honeycomb filler with flats, embossed or cup flats, in which the embossed upper surface provides a center cushion to support the egg, and filler flats, which function as both filler and flat The latter has not become popular in the egg trade

During recent years cases made of heavy pasteboard or fiber holding 15 or 30 dozen eggs, have been used extensively The cases are light and durable, but have not been found as satisfactory as the wooden case if eggs are to be shipped long distances or held in cold storage

TRANSPORTATION OF EGGS

The movement of eggs from producing centers to areas of consumption is largely by rail in car lots The number of eggs being moved by trucks, especially from production areas located within a few hundred miles of the large central markets has

been increasing rapidly A carload of eggs may vary from 400 to 600 standard 30-dozen cases Trailer trucks with a capacity of 500 cases are now common Large quantities of frozen and dried eggs are moved by rail and truck In warm weather both railroad cars and trucks are refrigerated, and in winter they are heated to prevent freezing the eggs

EGG PRICES

The price of eggs is determined by the supply of eggs of different qualities and the demand for such eggs The price tends to move with the general price level During World War II, under price control with a strong demand, quality was given little attention The price of eggs bears some relation to the price of feed, since feed cost represents more than one half of the cost of producing eggs The purchasing power of eggs in terms of feed tends to move in normal times in a cycle of about three years' duration

The price of eggs varies seasonally, with the peak of prices being reached in September or October and the lowest prices being paid in the spring and summer months

MERCHANDISING EGGS

After a producer has done his best to produce eggs of high quality and has been careful in his efforts to preserve their new laid quality up to the time they are ready for market, the final step is to market his eggs in the most profitable manner possible Some poultrymen are very efficient in the production of eggs, but relatively inefficient when it comes to actual sale of the product A very important factor in the marketing of eggs is to get them into the hands of the consumer just as soon as possible after they are laid

Direct to consumers Many poultrymen are so located that consumers can call at the farm or commercial poultry plant for their eggs *This is the most direct* method of marketing eggs Other producers may assume the responsibility for de livering eggs direct to consumers in their homes The producer is usually able to secure a higher price for his eggs by disposing of them in this way, but he may find that the costs involved in making numerous individual deliveries to customers scat

tered over a wide area are so high that other methods of marketing may be more efficient

Producers located on well traveled highways may use the roadside market as a method of selling eggs direct to consumers Persons located near large consuming centers can often obtain retail prices for eggs shipped to individuals in 15 or 30 dozen lots The person receiving the eggs may divide them with friends or relatives Hospitals, hotels, restaurants, steamship lines, and railroads may buy eggs direct from producers, provided they can be assured of uniform high quality the year round

Through co-operatives The origin and development of co operatives for marketing eggs would indicate that poultrymen have not always been satisfied with the marketing system available to them and that they have tried to improve conditions by co-operative effort The growth and development of co operatives in this field is ample evidence that they have succeeded

The co-operative marketing of eggs has benefited producers in a number of ways Returns are made to the producer on a quality basis, which is an incentive in the production of good eggs Through educational programs the producer has been encouraged and trained to take better care of his eggs which has resulted in a relatively high grade product Because of the increasing bargaining power, due to large volume and controlled quality, the co operative in many instances has been able to secure for its members a relatively larger share of the money which consumers pay for eggs than is the case in most other methods of marketing

To the country storekeeper This is one of the oldest methods of marketing eggs and is one of the most inefficient Usually the eggs are traded for groceries or other merchandise Since little or no consideration for quality is made by either the storekeeper or the producer, this method of marketing eggs becomes wasteful and results in low returns to the producer

To hucksters In rural sections of the country where poultry production is an important industry, producers sell eggs to hucksters, who pick up the eggs from farm to farm and then sell them to retailers or wholesalers In many sections this method

of sale is being replaced by the services performed by co-operatives

To packing plants. In the Middle West, and to some extent in other sections of the country, large egg and poultry packing plants are in operation. Enormous numbers of eggs pass through these plants. For collecting eggs from poultry farms, many packing plant operators use their own trucks, some of which are insulated and have mechanical refrigeration to aid in the preservation of egg quality in hot weather. In the packing plant eggs are candled, graded, packed, and forwarded by rail or truck to wholesalers or other receivers in large consuming centers.

Because of the large volume of eggs obtained directly from producers, packing plant operators probably have greater opportunities than most other groups of egg buyers to encourage the production of high-quality eggs on the general farms of the country. If the packing plant operator will increase the practice of buying eggs on a graded basis, paying a premium for eggs of superior quality, it will have a tendency to discourage the producer who persists in producing low-quality eggs.

To jobbers or wholesalers. Some producers ship their eggs to jobbers or wholesalers located at the terminal markets in the larger cities. The eggs are usually shipped by express but may be shipped by either rail or truck. Wholesale receivers consist of two types, commission merchants and wholesale dealers. Commission merchants operate on a commission basis, and wholesale dealers buy the eggs and then sell them, taking a chance on making a reasonable margin of profit on the transaction. Receivers usually assume the cost of financing the goods and the credit risk.

To the retailer. The retailer is the final link in the marketing chain. Important outlets for eggs and poultry are independent grocery stores, specialized dairy stores, and chain stores. Shipping to a successful retailer who caters to a high-class trade is a very efficient way of marketing eggs.

COLD STORAGE

Slightly less than one half of the total egg production of the United States occurs in March, April, May, and June. As eggs are a year round food, some means must be employed for pre

serving them from the surplus production season to the season of under production

Various methods have been used, such as salting, brine pickling, and immersion in water glass or limewater, but no medium has been found that will preserve shell eggs as satisfactorily from season to season as will cold air Without any other preservative, a sufficiently low temperature will keep eggs in edible condition nearly a year and in very good condition for six to seven months, the usual length of time eggs are held in storage Because the heaviest production of eggs is in the spring, most eggs are stored in that season Practically all eggs have been withdrawn from storage by the first of January

As an additional preservative measure, many eggs are oil treated before they go into storage The most common method of oil processing is to open dip the eggs in a light mineral oil Special machines are now available which do the work efficiently and with a minimum of labor The oil treatment partially seals the pores in the shells As a result it slows down the rate of loss of carbon dioxide, retards the loss of moisture, and tends to retard or inhibit changes in eggs The protection of shell eggs by the use of plastics is now being given consideration

Cases of eggs in the storage room should be piled in such a manner as to permit free circulation of air around each case Eggs should not be stored in rooms with other produce

The ideal temperature in the egg storage room is 29° F with a variation of not more than 1° F in either direction Regardless of the temperature in the storage room, it should be kept as nearly uniform as possible A humidity held just below the point at which mold is likely to grow is desirable Most warehouses attempt to hold the relative humidity between 88 and 92 per cent Some artificial means of providing constant air circulation is necessary when high humidity is maintained

HOME PRESERVATION

Of the various methods used in the home preservation of shell eggs, the water glass method seems to give the most satisfactory results One quart of commercial water glass to 9 quarts of clean water is the mixture usually recommended Good

results have been reported with mixtures as low as 1 quart of water glass to 10 quarts of water Most any type of container can be used The container should be tightly covered Much better results will be obtained if the eggs are stored at relatively low temperatures—60° F or below

FROZEN EGG PRODUCTION

The preparation of frozen egg products is now universally recognized as an efficient means of conserving eggs Freezing and holding liquid whole eggs, whites and yolks, or the separated whites and yolks, prevents decomposition and minimizes deterioration for an extended period of time, thus preserving the original quality of eggs until they are required for use The holding temperature ranges from 0° F to — 5° F Since egg production occurs on a seasonal basis, freezing affords an efficient means of preserving eggs for use throughout the year

The demand for high-grade frozen eggs to be used in the manufacture of dressings, frozen foods, and bakers and confectioners' products has become so great that packers find it profitable to use larger quantities of sound fresh wholesome eggs of uniform quality for these purposes The rapid development in the frozen egg industry is indicated by the increase from 46 million pounds in 1921 to 392 million pounds in 1946

DRIED EGG PRODUCTION

The dried egg industry increased enormously during World War II In 1938 slightly more than six million pounds of dried egg products were produced The peak production was in 1944 when almost 321 million pounds were produced The production of this product has fallen sharply since the foreign demand has all but disappeared

Bakers and other food industries are large users of dried eggs

Eggs normally contain approximately 73 per cent of water During the drying process about nine tenths of the water is driven off and the eggs are reduced to about one fourth of their original weight. To make one pound of dried material, 36 to 40 average sized eggs are required, which represents ap-

proximately three times the monetary value of a dozen eggs in the shell About 3½ pounds of liquid whole egg, 2½ pounds of yolk, or 7½ pounds of white is required to produce one pound of each in the dried state

It is doubtful if individual consumers will be interested in using dried eggs to any extent

USES FOR INEDIBLE EGGS

No matter how careful and efficient our marketing system may be, there are always some eggs that lose their value for human food A part, but by no means all, of these eggs go into industrial products Printing, textile, and chemical plants use considerable quantities of them Spoiled eggs, however, are a heavy loss to the poultry industry since their value is a small fraction of that of edible eggs

Tanner's egg yolk is one of the important inedible egg products It is made from those eggs, of both the hen and the duck, that are unfit for human consumption but do not have a repulsive odor The term tanner's egg yolk' refers to a product made from whole liquid egg and not from the yolk only as the name implies The annual production of this product may reach a total of six to seven million pounds

Egg albumen has a number of uses It is used to season drum heads and banjo heads and as an adhesive for a variety of purposes, including the attaching of gold lettering and gold and silver leaf to leather It is used in the production of certain types of photographic negatives and for albumen colors in textile printing

In point of quantity, more spoiled eggs are used for hog feed and fertilizer than for tanning and the arts The material is rich in proteins and if decomposition has not progressed too far is readily eaten by the animals It may be fed in mixtures with grain or other feeds

Eggs and egg products are subject to the provisions of the Federal Food, Drug, and Cosmetic Act of 1938, when they enter interstate commerce or otherwise come within the jurisdiction of the act They must meet the standards set up under its provisions In general, the law prohibits the sale of adulterated and misbranded foods It requires that the egg and

egg products be sound, wholesome, and edible and that their labeling be in no manner misleading.

MARKETING POULTRY

The marketing of poultry meat in the United States is, in general, a by-product industry. Little poultry, except broilers, turkeys, and ducks, is raised for its meat value alone. These exceptions are highly developed industries and have special marketing problems of their own which are being solved in particular cases to meet the particular problems.

On general farms poultry is kept to supply both eggs and poultry for the table but primarily to produce eggs for sale. Under these conditions the great bulk of market chickens consists of old stock, such as hens that are sold when they become unprofitable as layers and young surplus males produced in the course of raising pullets to renew the laying flocks. Since sexed pullets are now generally available fewer cockerels are raised on general farms.

Chickens are raised and marketed in practically all sections of the United States. There are centers of heavy production in the eastern states and on the Pacific Coast, but approximately 50 per cent of the supply is produced in the East North Central and the West North Central States, principally on the general farms of that region. According to reports of the United States Department of Agriculture, Iowa led all other states in number of hens and pullets on farms, January 1, 1948, followed in order by Minnesota, Texas, Missouri and Pennsylvania. The States of the Middle West not only raise more chickens and other poultry than other regions but they also have a greater surplus above their own needs which is available for shipment to the large centers of consumption.

In recent years many poultrymen have found that local markets are desirable for both live and dressed poultry. This is because the buyers come to the farm or the producer can deliver his product directly to the buyer, thus avoiding much labor in preparing the product for shipment, shipping costs, shrinkage and selling charges. Local markets may not be so particular about grades. From the standpoint of both producer and buyer, however, poultry should be sold on a graded basis. If private trade is catered to, the individual customer is prin

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cipally concerned with the appearance, size, and quality of the individual bird received. When there is large enough spread in prices between live and dressed poultry and a good local market available, it will undoubtedly pay for those who have the facilities and the inclination to sell poultry dressed. Poultrymen dressing 50 or more chickens per week will find an investment in a mechanical picker worth while. A study made in New York shows that a skillful operator can operate one of these machines and produce as high a quality dressed chicken as is done by hand picking. The number of poultry being moved to market through producer co-operatives has increased in recent years and is proving to be a very satisfactory method of sale in the localities where such co-operatives are operating. In certain eastern states a few poultry auctions, both private and co operative, sell poultry. Some of the auctions operate by charging a fee for each coop or pound of poultry sold, while others operate on a co operative basis.

The problem of transportation. In most cases the large poultry-consuming cities are located at considerable distances from the surplus-producing areas of the Middle West and other sections. The problem is one of moving the poultry from the sources of production to the points where it is consumed in such a way as to insure its arrival in the best possible condition and at the lowest possible cost. In the shipment of poultry to New York City some lots may move from points considerably more than 1,000 miles away. The individual producer seldom has either the volume of product or the available facilities to cope with the problem efficiently. To meet this need the business of poultry packer, shipper, and co-operative has developed.

For efficiency and economy in handling, the poultry sold in small lots from individual farms distantly located from the markets must be assembled at concentration points and shipped, either alive or dressed, in larger lots, usually in car lots or in large trucks. Much of the poultry is dressed at these concentration points before being shipped to the final markets. This requires establishments especially equipped to feed, slaughter, pack, and refrigerate the poultry. As dressed poultry is highly perishable unless handled at low temperatures, the use of refrigerator cars or refrigerated trucks for shipping is essential. In shipping live poultry considerable d[illegible]s, cars or trucks

especially constructed for this purpose must be used, so that the poultry may receive proper care and feeding in transit and heavy shrinkage in weight be avoided

The transportation of poultry from areas of production to the points of consumption involves many complex problems and the performance of numerous services

Seasonal production Farm poultry production is seasonal in character Chickens and other species of poultry are normally hatched and reared during the spring and summer The crop of surplus poultry available for sale from farm flocks is not large until June or July, and the surplus does not continue beyond January In recent years there has been a trend toward earlier hatching In some instances poultrymen are hatching as early as December or January The pullets begin laying in June or July and continue to lay well through the fall and early winter months They are all marketed in December or January at about one year of age A new lot of chicks is then started In this system the birds are kept for about one year instead of the usual eighteen months This practice tends to equalize meat production over the entire year

Specialized broiler and fryer production has developed rapidly during the last decade This development has taken place in such areas as the Del Mar Va Peninsula the Shenandoah Valley of Virginia Georgia Arkansas and to a limited extent in other areas On many farms the raising of broilers and fryers is the only enterprise the chicks being purchased from commercial hatcheries The chickens are usually raised to an age of about three months at which time the entire crop, both male and female is sold Farms of this kind raise about three crops a year A single farm in the Del Mar Va area may produce several hundred thousand broilers each year

Most of the hens marketed are sold during the late summer and fall after they have finished laying for the year The heavy demand for poultry particularly turkeys at Thanksgiving and Christmas time stimulates heavy shipments at those times

Because dressed poultry arrives on the markets during the fall and early winter in quantities larger than can be currently used the surpluses are held in cold storage until late winter and spring when receipts are inadequate Cold storage therefore serves as a balance between supply and demand With

cold storage, the poultry farmer is enabled to market his poultry when it is at its prime and at better prices than otherwise would be likely to prevail Total stocks of poultry in cold storage reach a peak in December or January and then gradually de cline, reaching their low point in the late summer or early fall

Selection of market poultry Since the production of poultry meat is, in large measure, a by product of egg production, the first step in its marketing is selection The problem of selection is usually simple in that birds to be marketed are those that are no longer needed in the production of eggs or the replacement of the laying flock It is all too frequently the custom to simply crate up the birds that are ready to be sold and sell them to the first trucker who comes along or ship them to a receiver located at a terminal market with the hope that the returns will cover all costs and perhaps return some extra cash to the producer Millions of dollars are lost annually by poultrymen who do one or more of the following things sell thin birds, sell sick birds mix young and old birds together when cooping them for mar ket, fail to grade and coop chickens according to size and qual ity, and overcrowd the market coops so that some birds are suf focated A little attention paid to selecting the market stock and the orderly marketing of it may mean the difference be tween profit and loss on the entire poultry enterprise

A 'production cull' is frequently an excellent market bird if it is marketed before it loses weight The market cull is a bird that is thin, emaciated, or otherwise unfit for sale A mar ket cull is almost invariably a production cull, but a production cull is not always a market cull Good health, as indicated by good fleshing, good feathering, and general sturdy appearance of the bird is the first point to look for in market birds The bird should be chosen with the factors in mind which go to make up dressed poultry quality These factors are as follows

1 *General appearance* a Shape Brick Shape —long moderately deep, well filled out Breast full and rounding, broad and deep Keel straight and long

b Fleshing Well fleshed —all bones well covered partic ularly keel and back Flesh itself should be firm yet pliable, soft and fine textured Fat well distributed but not too much, particularly in abdomen

c Preparation Evidence of special fattening—soft white skin, location of fat Properly starved—no food present in crop, abdomen not distended Properly killed and bled—no prominent, dark veins Picking—no pin feathers, dry, semi scalded wax plucked Display—head neatly wrapped, feet clean, attractively packed

d Skin Fine textured, soft free from bruises, blotches, sores, cuts and tears Color—white or yellow according to breed if yellow, the medium shades are preferred

e Legs and wings Short and well fleshed

2 *Size* In general, toward the upper limit of the classification to which bird belongs

3 *Age* Preference is for the younger birds in the classification

4 *Breed* Preference is for heavy breeds

5 *Sex* Where classification permits both sexes the female is preferred

6 *Health* Evidence of disease of any kind disqualifies bird

Frequently the market value of poultry may be increased by fattening, even for the live market Birds that are in poor to average flesh or in full molt can often be confined and grain finished increasing not only the actual weight but also the value of each pound in weight Fancy quality stock brings a few cents more per pound than does poor or average stock

Fattening During recent years special feeding of poultry has been used primarily for holding birds for a few days until they could be killed instead of holding them for a long feeding period Some processing plants have large battery capacity in which birds are held and fed until their shrinkage, which occurs in moving them from the farm to the plant, is recovered This reserve supply also insures a steady flow of birds through the processing plant, resulting in greater labor efficiency

The type of fattening employed depends on the birds to be fattened the market for which they are being prepared and the condition in which they are sold, alive or dressed The purpose of fattening poultry for the market is (1) to obtain a gain in weight and (2) to improve the quality of the flesh and thereby secure a higher price Producers fatten or finish poultry to a less extent than they do any other class of livestock Many

mature hens are usually in a fairly good condition of flesh when marketed, and special fattening ordinarily is not required Others may be improved by fattening Birds raised commercially for the broiler trade, if well grown, usually do not need any special fattening The younger birds ordinarily make the best gains

In general, there are three types of fattening procedures range, pen, and battery

Range fattening consists of allowing the birds range with an increase in the grain ration particularly corn This method is used largely with turkeys, roasters and other large birds

Pen fattening consists of partial confinement of the birds in pens (about 2 square feet per bird in flocks of 20 to 30) The grain portion of the ration may be increased or the birds may be fed moistened mash to produce a softer flesh Pen fattening is used with fryers roasters, fowls, broilers ducks and other birds where conditions do not permit battery feeding profitably It is probably the best method to use where birds are marketed alive because it produces a firmer flesh than battery feeding

Battery fattening, sometimes called milk feeding Healthy, strong birds are placed in total confinement (6 to 12 birds in a 3 foot square battery with just sufficient room to allow free movement) Starve the birds 24 hours in order to encourage them to eat the feed greedily A semiliquid diet is usually fed. Fattening rations are discussed in Chapter 11 If at any time the birds should go off feed omit one feeding Clean pails and troughs will help to prevent this occurrence

Battery fed birds should be marketed dressed, as the delicate soft flesh will not stand up under live shipment

MARKETING POULTRY ALIVE

New York City is the largest live poultry market in the country No general rule as to which market should be used can be laid down other than that each producer should study his own possibilities and use the one that yields the highest net return to him A little study of market quotations at each of the available markets the customary marketing charges at each and the transportation rates may show that some profitable changes are possible Sale at the farm to trucker buyers or to local buyers may be often advantageous This method of sale

is rapidly becoming the most popular method of moving live birds from the farm

It pays to select birds carefully in shipping alive Put only one type of classification of birds in one coop Do not mix fowls and broilers or Rocks and Leghorns

Remember that the quality of all the birds in the coop is judged by the buyer as being like the poorest bird he can find in it Never send market culls They are simply picked out and discarded when the coop arrives on the market. The producer pays the transportation charges on the culls, but they are not even weighed on the market The culls drag down the price of the rest of the lot. Trucker buyers sort out the culls and leave them at the farm

It usually pays to start marketing low producing hens as early in the season as possible as more money is received per pound The lowest price for fowl usually comes in October

In moving birds use a standard shipping coop Such coops can usually be borrowed from a receiver or if not can be purchased at relatively low cost Trucker buyers usually supply coops A standard coop for chickens—3 feet by 2 feet by 12 inches high—holds depending on the weather 14 to 16 small fowl 14 to 20 broilers or pullets or 8 to 10 ducks For larger birds use a coop 16 or 20 inches high holding from 10 to 12 large fowl or roasters 5 to 6 turkeys or 8 to 10 geese

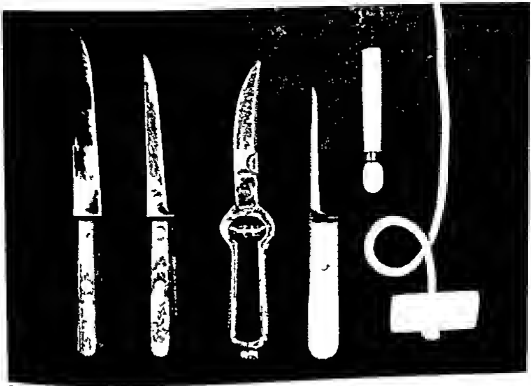
The shrinkage will usually be from 3 to 15 per cent soft meated milk fattened poultry shrinking more than corn fattened birds

Shipments should be made to arrive on the best market days for your market 2 to 3 days before a Jewish or legal holiday or on Thursday of an ordinary week in New York City

KILLING PICKING AND COOLING

Where there is a local market it is often possible for the producer to profitably dress his poultry for sale to the retail trade Birds to be dressed may be fattened to secure the maximum fleshing and quality of meat

The crop must be empty and the intestines also should be as nearly empty as possible For this reason the birds should be starved at least 18 to 24 hours before killing Water should be allowed at least for the first 12 hours of this period to help



Courtesy L M Hurd

Tools for use in killing and dressing poultry From left to right, knife for general use, knife for splitting broilers, bone shears, bleeding and sticking knife, pinner, and cord and block for hanging up a chicken

clear out the intestines These practices improve the keeping qualities and flavor of the meat particularly if dressed birds are held for a few days

Killing. The old fashioned ax and chopping block method of killing bruises the bird badly and frequently results in a poor bleed Also many health inspection services require that the head be left on the bird as evidence that the bird was healthy when killed

A good method is to suspend the bird at a convenient height for picking by means of a wire shackle or a loop of cord around the legs with the head down Grasp the head firmly with the left hand, being careful not to press the throat too tightly so that the flow of blood in the jugular veins is cut off Insert the knife in the throat and cut the jugular veins on the left side of the throat Then insert the point of the knife in the natural slit in the roof of the mouth, and holding the handle end of the knife close to the point or end of the upper beak push the knife back into the lower part of the brain When the proper

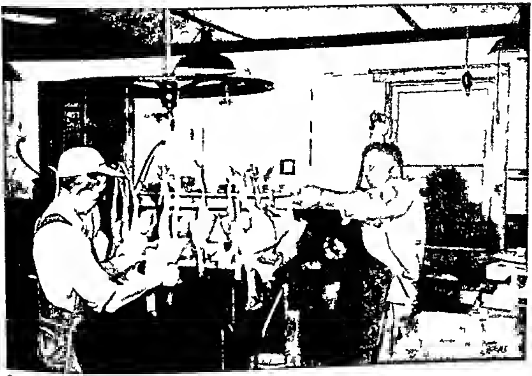
Courtesy Dr Elmer N. Searls

Dressing equipment for the small operator. From left to right, funnels and trough for bleeding and sticking, scalder with temperature control, and mechanical picker.

point is reached the bird will give a convulsive shudder and emit a peculiar squawk. Twist the knife to destroy the brain. This kills the bird instantly and is one of the most humane methods of killing. Attach a blood cup or weight to the beak by means of a hook to hold the bird more quietly and prevent the blood being spattered around. Funnels of sufficient size to hold the body of the bird and an opening large enough to allow the head to protrude are also used.

Methods of using electrically charged knives and other means of killing by electricity are being developed with the objective of insuring more complete bleeding. Automatic devices are now being used in commercial packing plants where large numbers of birds are killed and dressed. The ordinary killing knife is inexpensive and practical where only a few birds are prepared for market at one time and is still the method used in most processing plants.

Picking. There are several recognized ways of dressing poultry: dry picking, hardscalding, semiscalding, and wax picking



Courtesy Dr Elmer N Searls

Revolving wheel with light ropes attached for holding birds while pinning and scales and table for drawing poultry

Dry picking If the bird is to be dry picked it should be killed by debraining as this process also loosens the feathers Dry picking should be begun immediately since the feathers set quickly as the bird cools

Hold the bird firmly by the wings with one hand, then with the other, rapidly remove the main tail and wing feathers Then systematically remove the breast side thigh and leg feathers the soft body feathers the hip back neck, and finally the small wing feathers Pick fairly clean as you go but leave the pinfeathers to be removed later Pull with the feathers to avoid tearing the skin This method requires considerable skill

Hardscalding The bird is dipped in hot water (180° F) to loosen the feathers Always pass the bird through the water head end first but be careful to keep the comb, wattles and shanks out of the water Pass the bird rather quickly through the water, always going with the head end first so that the water does not actually touch the skin The vapor is all that is needed to loosen the feathers Three to five seconds is usually

long enough It is best to try a few feathers after each dip and when they come out readily the bird should be plunged quickly into cold water and hung up by the feet or legs Proceed to remove the feathers rubbing rather than picking the feathers out Scald picked birds do not keep long

Semiscalding In this method the water temperature is maintained between 125° F and 129° F The birds are kept in the water from 20 seconds to a minute or until the feathers are loosened The feathers must be picked out as in dry pick ing and the carcass carefully dried This method gives a dry picked appearance to the birds and can be done with less danger of tearing the flesh This is the most common method now in use in commercial poultry packing and is combined with wax picking It is very important that the birds be placed in the scalding tank just as soon as possible after bleeding and de braining Most of the picking is now done by automatic and mechanical pickers

Wax picking The wax method of picking poultry for mar ket was for several years very popular among operators of pack ing houses turkey growers and the larger broiler producers The attractiveness of the finished carcass appealed to the pro ducer as well as to the packer This method is most practical in a packing house or plant where large numbers of chickens are being slaughtered and where extensive automatic machinery is in use

The procedure can be briefly summarized in the following series of steps

1 Kill and bleed the bird by the debraining and bleeding method Rough pick the bird dry or use the semiscald method Remove the main tail and wing feathers and enough of the other large feathers to allow wax to seep into and around the remaining feathers pinfeathers and hairs

2 After picking the bird must be cooled and dried The time required for cooling and drying may be shortened ma terially if cold air is available

3 The bird is then submerged in melted wax being dipped in the wax twice to insure complete even distribution of the wax over the entire body The head and shanks are left free of wax Equipment should be provided to maintain the wax at a

constant temperature, and directions of the manufacture should be followed in order to insure maximum results

4 Cool the wax on the bird by dipping in cold water, spraying with cold water, or hanging in cold air until wax is set

5 Strip off wax, which should remove feathers and hair A few of the smaller pinfeathers may not be removed and will have to be removed by hand

6 Proceed with the chilling of the bird as by any of the other methods of picking

7 The wax may be reclaimed by melting and straining

Both the waxing equipment and wax are available from commercial poultry supply and equipment concerns Now waxing equipment suitable for the small operator is available

Mechanical pickers both in commercial dressing plants and for individual poultrymen are now in common use, and speed up the work of removing feathers very materially A mechanical picker is shown in the illustration on page 422

Cooling The animal heat should be removed from the bird as quickly as possible after plucking Dry or semiscald picked birds should be cooled in a dry chilling room or box with the temperature as close to 32° F as possible for at least 12 hours, preferably 24 Scald picked birds may be chilled in ice or cold spring water for 4 to 6 hours before sale or packing Many processing plants cool semiscalded birds in tanks or concrete tubs of ice water through which air is forced under pressure This reduces the time of cooling markedly

SKINNING BROILERS

Young broilers in large quantities can sometimes be disposed of by skinning This procedure has been profitably applied to the disposal of large surpluses of broilers from feeding experiments at the New York State Experiment Station at Cornell University Eight to twelve week old Leghorn broilers weighing from ¾ pound to as high as 2 pounds are starved then killed by dislocating the neck The feathers are quickly removed by skinning the bird A skilled operator can dress birds at the rate of 45 to 50 per hour

The steps in the skinning process, are as follows

1 Grasp a leg in each hand and pull until the skin breaks on one side between the thigh and body The bird should be held with the breast up, and head toward the operator

2 Holding the bird by the shank, grasp the edge of the skin between the thumb and ends of the fingers, at the break, and roll the skin back over the knuckles This makes it possible to get the fingers underneath the skin over the middle of the back where the skin can be broken at that point, and stripped in one movement down over the back, thighs, and drumsticks

3 Holding the bird around the body in front of the thighs with the back up, the remaining skin on the breast and between the wings on the back is removed by grasping the skin firmly at the base of the neck and pulling forward towards the head This removes the skin from the neck to which the head is at tached

4 Still holding the bird in exactly the same manner as in step 3, remove the skin from the wings by grasping firmly the large wing feathers near the body, and remove both the skin and feathers by pulling away from the body, one wing at a time

5 Still retaining the same hold on the bird, by a twisting motion remove the legs, taking as much meat from the back as possible

6 Take a firm grasp of the neck with one hand, and by in serting the index finger in the angle of the wishbone and grasping the wing by the thumb of the same hand pull the breast from the remainder of the body of the broiler

7 Remove the heart liver, and gizzard by twisting loose from the remaining viscera

8 In small broilers 1½ pounds or less, the back is not dressed There is very little meat on it In larger birds re move the remaining viscera from the back, beginning at the neck and working toward the rear

9 All sections of the dressed bird are placed in cold water or cracked ice immediately and allowed to cool

10 The gizzards are cleaned after they have been thoroughly chilled The work can be done much more rapidly than when the gizzards are still warm

The shrinkage from the live weight when only the breast, legs liver, gizzard, and heart are sold is 53 to 55 per cent The

backs may be sold for soup at 10 to 15 cents per pound This method of preparation is very rapid and makes it possible to use small birds, although broilers may be skinned up to 3 pounds Uniformity is not important This method of preparation is adapted to local outlets and the product must be moved into consumption rapidly unless facilities are available for freezing It makes an excellent form of poultry for the home freezer, or for the community freezer locker When wrapped in moisture proof paper, quick frozen and held at 0° F, it will keep for several months with little or no loss of quality

DRAWING POULTRY

Until recent years dressed poultry has been generally sold on the market in an undrawn condition Today the demand is very general for eviscerated or full-drawn poultry If the birds are not for immediate consumption the strictest sanitation should be observed in drawing the carcass If the content of the entrails comes in contact with the carcass there is the danger of bacterial infection of the meat Care should be taken in the drawing operation to avoid the possibility of breaking or cutting the entrails The following method of drawing is simple to carry out and results in a very satisfactory product

Singeing In order to remove the hairlike feathers common to all dressed poultry, (unless plucked by the wax method) birds should be singed before drawn The singeing should be done over an alcohol flame or the blue flame of a gas or oil stove

Removing the neck, crop, and windpipe Place the bird on the table with the head to the operator's left and the bird's back towards the operator's right side The neck is removed by making a cut on the back of the neck from the point of the shoulder up to the head Grasp the skin of the front side of the neck in the left hand thus drawing the skin tight across the back of the neck The cut is then made and followed by grasping the neck in the right hand and drawing it loose from the skin from head to shoulder Cut the neck off close to the shoulder and head

Remove the gullet, crop and windpipe by tearing them away from the skin down to the front body opening

Dislocating lungs and heart. In order to facilitate the removal of the entrails and other organs from the rear of the body, the heart and lungs are torn loose through the front opening by placing the first two fingers of the right hand into the body. The lungs are found on either side of the backbone and are forced down and loosened by the finger tips. Following the removal of the lungs the fingers are forced down into the body cavity and moved around in a circular fashion to dislocate the heart and other organs.

Removing the leg tendons and shanks. Since tendons are very tough, their removal greatly improves the tenderness of the leg muscles. The tendons are removed by cutting a slit along the outer side of the shank. The tendons may be separated one by one and drawn out by using either the forefinger or a small skewer or large nail. The sinews can be removed readily by first breaking the shank on the edge of a table and twisting the broken shank until the skin is broken and the foot hangs by the tendons only. Place the foot in a special V shaped hook, or in the crack of a door, and remove tendons by pulling, holding the carcass by the upper leg. The remainder of the shank should be cut off just below the hock joint. Do not cut the flesh of the leg above the joint when removing the shank, since in cooking the leg, meat would be drawn away from the joint. There are several good tendon pullers now on the market.

Removing the entrails. The entrails are removed through an incision made in the abdomen. Make the incision as small as possible along a line from the keel to the vent. Cut through the internal body fat, but avoid cutting the intestinal tract. Place the left index finger under the intestines close to the vent and make an incision encircling the vent, thus allowing for the removal of the entrails intact. Grasp the gizzard, located at the right side of the body cavity, in the right hand, holding the carcass steady with the left hand, and draw out the gizzard by a steady pull which should bring out all the entrails at one time.

The heart, liver, and gizzard, which are known as the giblets, should be removed from the entrails. The heart is removed from the heart sac and the bile sac is removed from the liver. Avoid cutting or breaking the bile sac. Cut through the muscle of the gizzard, halfway around, being careful not to cut the in-

ternal sac Fold back the sides and remove the inner sac with gizzard contents Unless perfectly clean wash the heart, liver, gizzard, and neck, and place within the body cavity Wipe off any blood or soiled spots that are on the carcass

Removing the oil sac. The oil sac is located on the back of the fowl at the base of the tail It is removed by cutting under the sac towards the tail

TRUSSING

The object of trussing roasting birds is to hold the legs firmly to the body and push them forward to make the carcass compact and attractive There are several methods which can be used Before roasting, the carcass should be washed thoroughly inside and outside

Lay the fold of neck skin over the shoulders and bend the wing tips under and upon the shoulders Place the bird on its back with rump toward the operator Work the loop of a white string in between the body and the wings by passing it over the front of the bird Cross the string on the back and bring the ends up and cross them over the drumsticks near the outer joint Pull down tight. Carry the ends down the sides Turn the bird over and tie the string across the rump Trim off the ends A very quick method of trussing is accomplished by making a double cut in the skin at the side and to the rear of the abdomen on both sides The legs are put through these straps of skin to keep them in place when being cooked

PREPARING A SPLIT CARCASS

In some instances it may be desirable to split a carcass for certain types of cooking, particularly broiling The carcass is split from tail to head on both sides of the backbone A cut is then made above the vent and the entire backbone and neck removed The head and shanks are then removed in the usual fashion A cut is then made around the vent to allow for the removal of the entire intestinal tract Hold the split carcass open with the left hand and grasp the gizzard in the right hand and draw forward thereby removing all organs, including the crop The two sides of the bird may then be separated along one side of the keel or left intact

DRESSING LOSSES

Table 69 shows the weight losses which may be expected in poultry because of killing, dressing, and drawing.

CUT-UP CHICKEN

In recent years more and more chicken has been sold at retail in the form of cut-up chicken. The poultry meat may be sold by the piece, thus enabling the consumer to buy breasts, legs, wings, backs, or giblets separately. Turkeys are often split in half or quarters and sold in this form. By adjusting the price

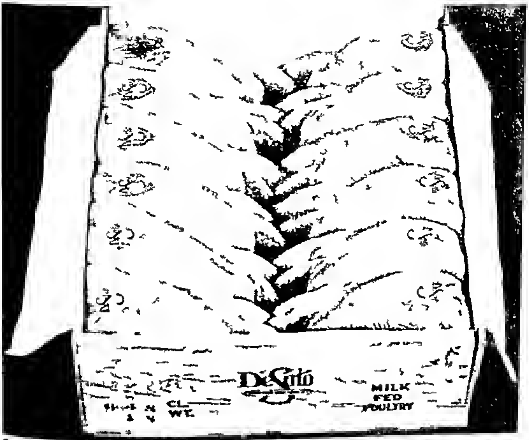
TABLE 69. WEIGHT LOSS DUE TO KILLING, DRESSING, AND DRAWING POULTRY

Class	Loss after Bleeding and Picking (Dressing), Per Cent of Live Weight	Loss from Dressed to Drawn, Per Cent of Dressed Weight	Loss after Dressing and Drawing, Per Cent of Live Weight
Chickens			
Broilers under 3 pounds	12	30	38
Fryers 3–4 pounds	11	26	34
Light roasters 4–5 pounds	10.5	24	32
Heavy roasters over 5 pounds	8	20	26
Heavy fowl	10	21	29
Turkeys			
Toms over 20 pounds	9.5	18	26
Toms 15–20 pounds	11	19	28
Hens over 15 pounds	8	16	23
Hens 12–15 pounds	9	17	25
Hens 8–12 pounds	11.5	18	27

(Beacon Milling Company, Cayuga, New York)

among the various parts little difficulty is experienced in the sale of all the parts. Many processors pack the parts of individual birds in attractive cartons, quick-freeze the product, and it is sold on the frozen food retail market. The complete preparation of poultry, ready for cooking when purchased by the consumer, is increasing at a rapid rate. Since most of this work is done in the processing plants, it should make possible the salvaging of many poultry by-products which in many small plants are now a total loss and may incur an added expense in their disposal.

Some poultry is sold frozen cooked, canned, or smoked.



Courtesy L M Hurd

A carefully graded box of high quality fowl Notice the uniformity of size and the plump well fleshed breasts

STANDARDS AND GRADES FOR POULTRY

Tentative standards for classes and grades of poultry have been set up by the Bureau of Agricultural Economics of the United States Department of Agriculture The use of these standards and grades is purely voluntary but a large volume of the poultry marketed is sold on the basis of these standards and grades

Standards for classes and grades have been established for live poultry, for dressed chicken for dressed turkey, and for dressed ducks geese, guineas and squabs There are standards for classes and grades of eviscerated federally inspected chickens and standards for classes and grades of eviscerated, federally inspected turkeys

The tentative standards for dressed ducks geese, guineas, and squabs include only three grades Grades A, B and C

Quality specifications for dressed turkeys vary only slightly from the specifications for dressed chickens

The following specifications for United States classes, standards, and grades became effective in January, 1950

DIGEST OF UNITED STATES CLASSES, STANDARDS, AND GRADES OF POULTRY

Classes In the new specifications, poultry is grouped as to kind and class The kinds of poultry are chickens, turkeys, ducks, geese, guineas and pigeons

The classes of poultry are based upon age, sex, and usual cooking methods The definitions of the classes include specifications for meat texture and color, skin texture, condition of breastbone, and condition of bill and windpipe in ducks and geese

Chicken classes are specified as broiler or fryer, roaster, capon, stag hen or stewing chicken or fowl, and cock or old rooster

Turkeys are classified as fryer, young hen turkey, young tom turkey, mature or old hen turkey, or mature or old tom turkey

Duck classes comprise the following Broiler duckling or fryer duckling, roasting duckling and mature or old duck

Geese classifications include young goose, and mature goose or old goose

Pigeons are classed as squabs and pigeons

Standards of Quality Established for Live Poultry

Live poultry Standards are based on the following factors (1) health and vigor, (2) feathering, (3) conformation, (4) fleshing (5) fat covering, and (6) the degree of freedom from defects Three quality designations are specified for live poultry, namely, A Quality or No 1 Quality, B Quality or No 2 Quality, and C Quality or No 3 Quality

Live poultry grades are specified as U S Grade A or U S Grade No 1 U S Grade B or U S Grade No 2, and U S Grade C or U S Grade No 3 In each of these grades a lot of live poultry shall contain at least 90 per cent, by count, of birds of stated quality, 10 per cent may be of the next lower quality, except that U S Grade C shall contain no birds below C Quality

Standards of Quality for Dressed and Ready-to-Cook Poultry Specified

The following factors are considered in determining the quality of individual carcasses (1) conformation, (2) fleshing, (3) fat covering, (4) the degree of freedom from pinfeathers and vestigial feathers, (5)

Summary of Specifications for Standards of Quality for Individual Carcasses of Dressed and Ready-to-Cook Chickens

(Minimum Requirements and Maximum Defects Permitted)

Factor	A Quality		B Quality		C Quality	
Conformation						
Breastbone	Normal Slight curve, ⅛" dent		Practically normal Dented, curved, slightly crooked		Abnormal Seriously crooked } If fairly well fleshed	
Back	Normal (except slight curve)		Moderately crooked		Seriously crooked } If fairly well fleshed	
Legs and Wings	Normal		Moderately misshapen		Misshapen	
Fleshing	Well fleshed, moderately long and broad breast		Fairly well fleshed on breast and legs		Poorly fleshed	
Breastbone	Not prominent		Not prominent		May be prominent	
Fat covering	Well covered—some fat under skin over entire carcass Broilers or fryers only moderate covering		Sufficient fat on breast and legs to prevent a distinct appearance of flesh through skin		Lacking in fat covering over all parts of carcass	
Pinfeathers	*Breast and legs*	*Elsewhere*	*Breast and legs*	*Elsewhere*	*Breast and legs*	*Elsewhere*
Dressed Pins and hair	Practically free	Practically free	Relatively few	Slight scattering	Numerous	Numerous
Ready-to-cook Nonprotruding pins	Practically free	Practically free	Few scattered	Few scattered	Scattering	Scattering
Protruding pins and hair	Free	Free	Free	Free	Free	Free
Cuts and tears [1]	Free	1½"	1½"	3"	No limit	
Disjointed bones	1		2		No limit	
Broken bones	None (except one nonprotruding if broiler or fryer)		1 Nonprotruding		No limit	
Discolorations [2]						
Flesh bruises	0"	¼"	¼"	1½"	No limit [3]	
Skin bruises	½"	¾"	¾"	1½"	No limit [3]	
All discolorations	1"	1½"	1½"	3"	No limit [3]	
Freezer burn	Few small (⅛" diameter) pockmarks		Moderate-dried areas not in excess of ½" in diameter		Numerous pockmarks and large dried areas	

The quality designations specified herein are not applicable to birds possessing any of the following conditions dirty or bloody head or carcass, dirty feet or vent, fan feathers or neck feathers or garter feathers, or feed in the crop

[1] Total aggregate length of all cuts and tears including incision for removal of crop or its contents.

[2] Maximum diameter of aggregate areas of all flesh bruises, skin bruises, and discolorations

[3] No limit on size and number of areas of discoloration and flesh bruises if such areas do not render part of carcass unfit for food.

the degree of freedom from tears, cuts, disjointed bones or broken bones; (6) the degree of freedom from discolorations of the skin and of the flesh and of blemishes and bruises of the skin and flesh; and (7) the degree of freedom from freezer burn.

Three qualities are established: (1) A Quality; (2) B Quality; and (3) C Quality.

The grades that are established for dressed poultry and ready-to-cook poultry are: (1) U. S. Grade A; (2) U. S. Grade B; and (3) U. S. Grade C.

Any lot of dressed poultry to qualify for U. S. Grade A or U. S.

Grade B shall contain at least 90 per cent, by count, of the carcasses, of the quality stated in the grade name The remainder may be of the next lower quality Any lot of dressed poultry may be designated as U S Grade C if it consists of carcasses of not less than C Quality

Unwholesome Poultry Excluded

The standards of quality and the specifications for grades of live, dressed, and ready to-cook poultry exclude all birds and carcasses which are affected by or show evidence of, disease or any condition which may render them unwholesome or unfit for food Likewise the various quality designations are not applicable to dressed poultry that is not free from the following conditions dirty or bloody head or carcasses, fan feathers or garter feathers or neck feathers, or feed in the crop

Weight Classes Are Recommended

The regulations contain suggested weight classes for dressed chickens turkeys, ducks, geese, guineas, squabs and pigeons and also for all kinds and classes of ready to-cook poultry

To qualify for the tentative U S grades for eviscerated chickens and turkeys, birds must be subject to federal inspection Licensed inspectors are available in most of the large terminal markets and in other cities where there is a concentration of dressed poultry[1]

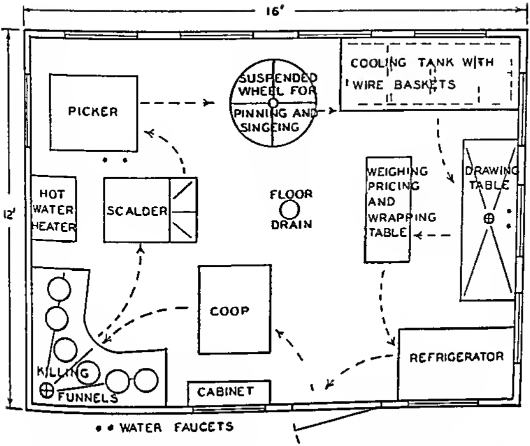
Some cities, such as New York require special inspection before poultry may be offered for sale in certain forms Complete information on local regulations may prevent complications in the sale of poultry

PLANS FOR A POULTRY DRESSING ROOM

Many poultrymen are now dressing a considerable number of birds each week for a retail, hotel, or restaurant trade In order to carry out the work of dressing poultry efficiently, a well planned dressing room is essential

Once the decision has been made as to building, equipment, and processing methods, a poultryman should draw a floor plan This floor plan should be drawn to scale and show the location

[1] Complete definitions of tentative U S standards may be secured by writing to the U S Department of Agriculture Production and Marketing Administration Poultry Branch Washington 25 D C.



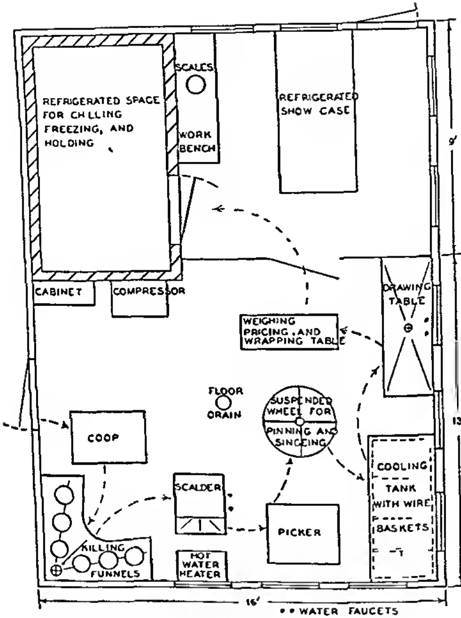
A suggested floor plan and flow diagram for a dressing plant where chickens are processed on order

of equipment to be used for the different jobs It should also show the location of the different work areas in relation to doors windows, and other building facilities

In working out a floor plan, an attempt should be made to provide for just as many of the factors for good building, equipment, and processing methods as is possible Several plans may be drawn before one is obtained which appears entirely satisfactory

On this page is shown a floor plan and flow diagram which may be used when chickens are processed on order, that is processed and sold within a short time

Many poultrymen are finding that their business is growing so fast they need a salesroom and larger storage facilities than are shown above A suggested floor plan to accommodate processing storage, and sales is shown on the following page A chicken or turkey dressing plant equipped with facilities for



Suggested floor plan and flow diagram for a chicken dressing plant with walk in refrigerated storage room and sales room.

freezing makes it possible to dress and hold large quantities of fowl, young chickens, or turkeys and to sell them over a period of time Some poultrymen may desire to add deep-freeze facilities inside the refrigerated rooms

SUGGESTIONS AND QUESTIONS

1 What changes have taken place in the marketing of eggs and poultry during the last 25 years? Explain why poultry and eggs of inferior quality are still found in considerable quantities in our markets today

2 It is a fact that the farm price of eggs received by farmers in some states is almost double that received by farmers in other states Why do such wide differences exist?

3 As an introduction to eggs and to the grading of eggs have the FFA members break out and identify all of the parts of the egg Compare the broken-out appearance of a fresh and a stale egg Follow this by an examination of fresh and stale eggs before a candling light Have each boy describe in his own words what he sees before the candler

4 Have each student in the class bring a dozen eggs from home Purchase a dozen eggs from each of three nearby grocery stores If eggs are sold by grade secure cartons of different grades

(a) Candle each dozen, observing the size of the air cell, the centering of the yolk, the yolk shadow, and the presence of abnormalities

(b) Break out four eggs from each dozen and note the condition of the white and yolk

5 Have the class secure several dozen eggs of uniform high quality

(a) Place one third of them in a room that has a fairly high temperature and low humidity

(b) Place one third of them in a room with a temperature from 50–60° F and if possible have a humidity of 75 per cent

(c) Place the remaining one third in cold storage at 29–30° F

(d) After one month remove the eggs and candle them Compare quality

6 Have each member of the class determine how much he receives of the money consumers pay for his eggs How can the amount be increased?

7 Make a collection of all the different kinds of packages used in egg marketing Compare the various types and taking costs into consideration decide which type seems to be the most satisfactory for the purpose for which it is intended

8 There are many ways of merchandising eggs Have each member of the class work out what he thinks is the most efficient method for his particular situation Those who do not have poultry projects might work with a neighbor

9 Outline a program for producing and marketing quality eggs

10 Obtain from the State Department of Agriculture copies of any laws regulating the sale of eggs within the state How do such laws affect the sale of eggs by members of the FFA class?

11 Explain why most poultry farmers sell poultry alive

12 Using the different temperatures recommended for the different methods of plucking birds, make a study of the time required to finish a bird by each method What is the principal advantage of the lower water temperature?

13 Make a visit to a poultry dressing plant How many different operations are involved in the dressing process? What operation takes the most time

14 During late April or May plan a broiler roast for the class Have the students in the class prepare the broilers and cook them

15 A poultryman has 400 fowl averaging 5 pounds each Using the information in Table 69 or information obtained from classwork what will the birds weigh dressed (blood and feathers)? What will the birds weigh drawn? The poultryman can get 30 cents per pound alive or 48 cents per pound drawn Which way should he sell them?

16 The sale of cut up chicken has increased rapidly during recent years How does the retailer manage so that all parts of the chicken are sold?

17 How is live poultry transported to market? What changes have taken place in methods of transportation in recent years?

18 New York City is the most important live poultry market in the United States Consumers in New York City often have to pay more per pound for live poultry than for dressed poultry Why do they do this and why is the cost of live poultry so high?

19 Make a study of the factors which make it possible to grow broilers and fryers at any time during the year How have they influenced the price of broilers and fryers?

20 If you were in the broiler and fryer business and your neighbor was producing market eggs would it be a good procedure to secure your baby chicks from the same source or strain of birds? Discuss

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CHAPTER 13

Poultry and Egg Shows

EARLY HISTORY

THE FIRST show exclusively for poultry held in America was at the Public Garden in Boston in November, 1849 In January, 1948, a century of poultry progress was celebrated by the Boston Poultry Exposition when the gigantic 100th Boston Poultry Show was held

Actually there had been many exhibits of poultry previous to the Boston Show As early as 1826 Embden geese were exhibited at the Rhode Island State Fair, and many and varied exhibits were made at other state and county fairs The interest created at these fairs gradually led to the exclusive poultry shows, which developed very rapidly after the Civil War

From this time on interest in poultry culture increased at a rapid rate Breeds were imported and a great deal of crossing and recrossing was done in an effort to obtain a breed and variety best suited to American farms This resulted in considerable confusion whenever poultry was exhibited and judged No standards were available and the opinion of the judges was taken as final In February, 1873, poultry breeders from the United States and Canada organized the American Poultry Association and established standards for the numerous varieties of domestic poultry A year later the first edition of the *American Standard of Excellence,* now called the *American Standard of Perfection,* appeared, and it has served as a standard for judging ever since

As the poultry industry expanded to its present-day three billion-dollar size in the United States, poultry shows became

more and more numerous As many as 300 major poultry shows have been held in the United States in a single year This does not include the many exhibits at fall fairs and the numerous shows held by county agricultural agents, boys' and girls clubs, and the Future Farmers of America

The Madison Square Garden Poultry Show in New York City was for many years the most important poultry show in this country Other large poultry exhibitions have been held in various cities and in connection with many important celebrations and expositions

One state government has a law in effect directing that poultry shows be held A section of the Jackson Poultry Law of Oklahoma states that for educational purposes and for encouragement of interest among the school children of the state, at each schoolhouse outside cities there shall be held a poultry show during the week commencing with the last Monday of November each year The county superintendent of public instruction in each county, the various officers of each school district, and the teachers of each school affected are directed by the law to co operate in the holding of the poultry show The board of officers of each school district is authorized and directed to expend not less than $5 00 and not more than $10 00 for each show This is unique in poultry legislation

As indicated in Chapter 2, most of the purebred chickens kept in the United States belong to the following breeds Plymouth Rocks, Rhode Island Reds, New Hampshires, Wyandottes, and Leghorns In all of these breeds the standard color of the feet, shanks, and skin is yellow, and the shanks are nonfeathered The most important varieties of these breeds are the Barred and White Plymouth Rocks, Single Comb Rhode Island Reds, New Hampshires and Single Comb White Leghorns These varieties are always popular at poultry shows

SELECTING EXHIBITION BIRDS

Previous to 1930 the main emphasis when selecting show birds was on type and color, characters which are often referred to as Standard characters This method of selection is still in use in the majority of our present-day poultry shows With the development of a large scale commercial poultry industry and the breeding of high producing strains of chickens there de

veloped a new type of judging which combined production and Standard characters. There was a popular demand among poultrymen for birds which were not only attractive in type and color but which were also efficient producers. This led to the addition of production or utility classes in many shows and to the first all production show held at Ithaca, New York, in 1922, under the supervision of the Department of Poultry Husbandry of Cornell University.

The first thing to do before selecting showbirds is to become familiar with showroom requirements. If the birds are to be judged on the basis of Standard characters, the poultryman should obtain a copy of the *American Standard of Perfection* and learn the description of the perfect type as given in this book for the breed and variety under consideration. The next step is to study the proper color requirements and the Standard shape until both are well in mind. When the birds are looked over for a preliminary selection, the individuals that closely resemble the Standard color and type should be comparatively easy to pick out. This first selection, however, is more or less general and should include all birds that show special merit.

After the general selection for shape and color has been made, a more careful inspection is necessary. Almost all birds will be found to have defects, that is, conditions of color and shape which differ from the Standard description. Some defects are considered more serious than others and are known as disqualifications. A disqualification is a defect that will bar a bird from receiving an award. There are a number of such defects listed in the *American Standard of Perfection* under the heading "General disqualifications." They include such imperfections as deformed beaks, crooked or otherwise deformed backs, split wing, slipped wing, wry tail, squirrel tail, comb foreign to the breed, absence of spike on a rose comb, side sprig on a single comb, decided bowlegs or knock knees, feathers, stubs or down on the shanks, feet or toes in birds with unfeathered shanks, entire absence of spurs on cocks, and many others.

In addition to these general disqualifications, there are also special disqualifications applying to each breed and to each variety. It is necessary to be familiar with all the disqualifications that apply to a particular variety and to eliminate all specimens with disqualifications from consideration in selecting

Courtesy Future Farmers of America

Students receive instruction in poultry selection from their vocational agriculture instructor. The successful poultry farmer must be able to separate the strong, healthy birds from the weak. A sound culling program often means the difference between profit and loss in a poultry enterprise.

birds for the show. Entering a bird which would be disqualified would be useless. Furthermore, it is very poor breeding practice to mate disqualified birds and perpetuate imperfections that have no place in a standard-bred flock.

After preliminary selections for shape, color, and disqualifications have been made, each individual should be examined carefully for minor defects. It is an exceptional bird that is perfect in all sections. Each class of birds listed in the *American Standard of Perfection* has a "scale of points." The perfect score of 100 points is divided into sections. The comb is given an appropriate number of points, the eyes are given their share, as are the tail, breast, back, and all other sections. These sections are further subdivided so that both shape and color are given consideration. Such divisions indicate the relative importance of the various sections as the more important ones are given the greatest number of points. By referring to the *Amer-*

ican Standard of Perfection one should be thoroughly familiar with the Standard requirements of the breed and variety which is being exhibited as well as the common defects which are likely to be encountered Since size and weight play an important part in the awarding of premiums, birds selected for exhibition should be as near Standard weight as possible The standard weights of the common varieties of chickens are given in Chapter 2

PREPARING BIRDS FOR THE SHOWROOM

Birds should be selected long enough in advance of the show to allow time for their preparation and training Under most conditions the feet shanks, and plumage of birds are likely to become soiled and dirty, and in such cases washing is desirable before the birds are entered in a show When first confined in a small coop birds are often frightened and do not show off to good advantage unless they are coop trained beforehand Often the training and fitting of birds are important factors in making awards

Coop training This process consists of placing each bird in a coop similar to the ones used in the poultry show, for several days before the date of the show Each bird should be handled two or three times each day in a manner similar to that used in judging By rubbing the wattles a frightened bird may be quieted and with patience on the part of the poultryman a bird may be trained to stand in such a way as to impress the judge in such characters as symmetry and type When handling a bird for observation it should be held in the left hand with the keel bone resting upon the palm of the hand The index finger is usually extended between the legs of the bird at the hock joint

This prevents the irritation caused by rubbing the joints together In removing birds from the coop grasp the wing at the shoulder with one hand and the thigh of the bird with the other and remove from the coop head first Birds should also be replaced head first This will eliminate struggling and flapping of wings which might seriously injure the wing plumage and bruise the birds

After the bird has been removed from the coop open the wings and examine the various parts of the body When accustomed to such confinement and handling the bird will usu

ally present a satisfactory appearance to the judge. Many birds of good exhibition quality are never seriously considered by the judge because of lack of training. Any bird that is flighty or attempts to hide in the corner of the coop when approached by the judge will not receive proper consideration. These conditions may be corrected by proper training.

Some exhibitors make an effort to remedy natural defects during coop training. High-angle tails are constantly bent downward, sagging wings are folded and pressed upward, and defects in shape may be improved by training birds to stand so as to conceal them. Other exhibitors remove off-colored feathers in order to improve the general color of the specimen. These practices are considered as legitimate fitting and are not usually questioned by the show management. Coop training should consist primarily of helping the birds to show their natural condition to best advantage.

Washing showbirds. Usually all white birds should be washed before they are exhibited. Dirty shanks, feet, and plumage detract from the normal appearance of a bird. The procedure for washing birds is not difficult once the process is known.

The first thing necessary is a warm room. Since many poultry shows are held during the fall and winter months, it is too cold to expect birds to dry naturally and the exposure to low temperatures may lower the resistance of the birds to certain respiratory infections. Birds should dry slowly for best results, and therefore the room temperature should be about 85° F. to 90° F. if possible. If this cannot be arranged, the drying coops may be placed near a stove where a good fire will keep the birds comfortable. The room should be free from drafts. The drying coops should be free from all dust and dirt, and clean straw or shavings should cover the bottom.

Soft water gives much better results than hard water and a good grade of mild soap should be used. Three tubs of water are necessary. The first tub should contain soft water at a temperature of 85° F. to 90° F. to which has been added a sufficient amount of mild soap flakes to make an abundant foam of suds. The soap should not be rubbed into the feathers as it is difficult to remove completely. The second and third tubs are for rinsing and should not contain soap. The temperature

of the water in the second tub should be lukewarm and in the third tub not less than 70° F. A few drops of bluing in the third tub will help whiten the birds, although the addition of too much bluing may cause streakiness.

The birds should be held on the palm of the left hand and immersed in the soapy water. Sponge until all the dirt is removed from the plumage. All feathers should become entirely soaked as the rubbing of dry feathers breaks them. After the feathers are properly soaked, the entire body of the bird should be lathered. On extremely dirty or soiled spots rub or brush the spots until they are clean. All rubbing should be done with the grain of the feathers. Remove the dirt from the shanks and feet with a stiff brush.

The next problem is to remove all soap from the feathers. If this is not done completely, the feathers will not fluff in a natural manner and an unsightly bird will result. The bird is first soaked for two or three minutes in the second tub of water and is then drawn through the water three or four times against the grain of the feathers. A thorough rinsing in the third tub should remove all of the soap. When the birds are removed from the last rinsing, the water should be pressed from the plumage. A bird may be washed in about 15 to 20 minutes, while it may take 12 to 18 hours for the drying. The exhibitor should be sure to take the birds to the show in a clean coop and exercise care in preventing the soiling of the plumage after the washing and drying have been completed. Birds should not be crowded, and the coop should be deep enough so that combs will not rub against the top of it. If birds are to be shown as singles they should be shipped or transported to the show in individual coops. Birds that are to be exhibited in groups, trios, or pens should be allowed to run together before they are placed in the show coop. This precaution may decrease the chances of injury caused by fighting if strange birds are placed together.

Birds which are to be entered in production or utility classes in a show are usually not trained or washed. With such birds, however, a good plan is to see that the shanks and feet are clean, that broken plumage is removed, and that a little Vaseline is used to brighten up the comb and face. Do not get the Vaseline on any part of the plumage.

BENEFITS OF THE POULTRY SHOW

What the exhibitor may learn at the show is as important as what he may win This is particularly true of the beginner To really know how to judge and to be able to recognize quality, the exhibitor must compete in the showroom This gives the breeder a definite idea as to how his birds compare in production quality and Standard characteristics with the stock of other breeders There is opportunity to look over the birds of other exhibitors, and exchanges or purchases may be arranged In addition to the personal satisfaction of winning in a show, there is usually some advertising value, especially if the exhibitor is fortunate in having birds that win some of the awards The most successful exhibitors and breeders of the present day acquired much of their success by learning from their mistakes made in poultry shows of former years

CLASSES OF ENTRIES

Birds entered in poultry shows are usually divided into the following classes (1) single entries, (2) pairs, (3) trios, and (4) pens The most popular entries are in singles and pens

Individuals in single entries compete against each other in four groups pullets, hens, cockerels, and cocks Females under one year of age are entered in the pullet class, and males under one year of age are entered as cockerels All entries over one year of age are entered as hens if they are females, and as cocks if they are males Pens consist of a male and four females of the same age and variety The male is considered one half and the females the other half in arriving at the total score of the pen

CARE OF BIRDS AFTER THE SHOW

Very often the exhibitor becomes careless in the handling of his birds after a show It is a dangerous practice to return the birds immediately to their regular quarters with the general flock The birds should be isolated for two weeks after their return to the farm Thus if any disease has been contracted it will not spread to the entire flock, as this period of quarantine permits the owner to check on the health of the returned birds before they are again placed in their regular quarters Many poultrymen with large commercial flocks make it a practice not to re

turn to the farm birds *which have* been exhibited at shows These birds are usually sold for market purposes The disease hazard, in recent years has reduced materially the number of entries in production classes at poultry shows

PREMIUM LISTS

A premium list is an important item for the show management to work out in advance The first essential of such a list is the group of classes to be considered in competition Such an advance list will eliminate confusion and will inform the exhibitor as to the classes in which he may enter his birds for competition

The premium list should also state the breeds and varieties that will be considered in competition In addition to classes for all the popular varieties, a miscellaneous class is often established in which the few uncommon varieties may compete against each other

In addition, the premium list should also contain any special rules of the show, the entry fee to be charged, the premiums to be awarded, and whatever other information is necessary for the guidance of exhibitors Many exhibitors like to know in advance the names of the judges who will make the awards in the various classes, and such names should be included in the premium list if they are known at the time the list is made up The cost of the premium list is often more than covered by advertising which it may include

PREMIUMS

Prizes won at poultry shows seldom pay for the expense involved in preparing and exhibiting Awards at the smaller shows are usually limited to ribbons or special prizes donated by public spirited citizens At the larger shows loving cups, cash awards ribbons, and many special prizes are offered This creates greater interest in the competition and has the effect of increasing the number of entries in the various classes

PRACTICES IN THE SHOWROOM

The practices followed in the showroom by either the standard judge or production judge will not vary materially The judge will secure from the secretary of the show a record book

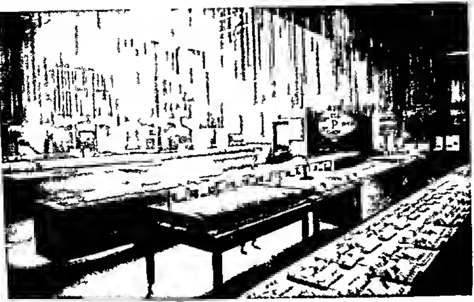
indicating the classes to be judged and the coop numbers of the birds Before handling any birds, the judge usually spends several minutes going over the class in order to get a general idea of the range in quality of the birds as far as it may be de termined by general observation from the outside of the coop The judge must exercise care and patience in handling the birds as hens or pullets in heavy production may be injured easily by rough or careless handling The general type of each bird may be determined from the outside of the coop Very often the individuals must be posed in order to see them in a natural position, as many birds are likely to assume a squatty' position when placed in the exhibition coop This is especially true in case of the heavy breeds Notes are usually made by the judge either on the coop tag or on a writing pad Most all judging is done by comparison, the score card system being practically obsolete

When the judge has completed his inspection of the birds by observing them from outside the coops, he will then handle each bird in the class Care must be taken in removing the birds from the coops, as broken wing and tail feathers or other injury may result Most judges hold the bird in the left hand and examine the various sections with the right hand After each bird has been examined the judge will often be able to elim inate immediately a number of birds from competition In large classes where the number in the class has been reduced to eight or ten birds they may be brought together in special coops where a closer examination and comparison can be made

After the placings have been made and time permits the judge should made it a practice to answer any questions which may be asked giving the exhibitors or others interested the benefit of his reasons why certain awards and placings were made The judge should personally check his placings in his record book and see that the coops are properly marked by the use of stickers or some other method indicating the awrds made

EGG SHOWS

Egg shows and demonstrations in the proper candling and judging of eggs have been useful to both producers and consumers, and have served as natural outlets of the information



Courtesy Poultry Department Purdue University

The Purdue Egg and Chick Show This show is conducted by the poultry husbandry students at Purdue University West Lafayette Indiana

obtained through research and practice as to the characters affecting the quality of eggs For many years emphasis was placed on the external characteristics of eggs with little or no consideration given to interior quality Many of the commercial egg score cards now in use at egg shows allot 50 out of 100 points to interior quality Nearly all judging is done by the score-card method

Several colleges of agriculture have established egg shows and many poultry shows have egg classes as an extra feature Some states combine the egg show with a baby chick and turkey poult show One of the earliest egg shows established in the United States was the Purdue Egg Show held annually at Purdue University West Lafayette Indiana It is often referred to as the Pioneer Egg Show of America The show is conducted by the students in the Department of Poultry Husbandry The object of the show as stated in the annual catalog is to encourage the production of more and better eggs and to give an instructive demonstration of the most approved methods of scoring packing and grading eggs

In addition to the regular classes of eggs—white and brown—a special class is often established by the show management in

order to add interest to the competition Prizes were offered in a recent show held in the East for the brownest dozen, whitest dozen, largest dozen, smallest dozen, oddest dozen, and the most novel dozen The most novel dozen was to be decorated, painted, colored, or inscribed

The egg score card on page 452 is used for exhibition judging in which only exterior quality is considered

The score card on page 453 has been used in New York State 4 H Club work, in which both interior and exterior quality are considered

The rules and regulations applied at egg shows are usually very simple The following rules and suggestions were made in the announcement of the 1948 Midwest Egg, Chick, and Turkey Poultry Show held at Iowa State College in regard to eggs

Rules and regulations. No entry fee will be charged, but eggs will become the property of the show and will be sold to defray expenses Eggs will not be sold for hatching purposes

Competition is open to anyone except Iowa State College Poultry students

Entries are not limited and any contestant may enter any number of dozens of eggs

Judging will begin upon arrival of entries

Disqualifications. All eggs falling under the following classes will be disqualified and barred from all competition

1 Entries that average below 22 ounces or above 28 ounces per dozen

2 One or more cracked or broken eggs (Send an extra egg or two in the event that breakage occurs in transit)

3 Stale eggs, as evidenced by abnormal size of air space, blood rings or blood clots, double yolked eggs

4 Eggs shown out of class

5 At least 12 qualifying eggs per entry are required *Note.* Eggs from trap nested hens with penciled data on them will not disqualify or be discriminated against However, penciling should not be excessively heavy.

Selection. I *Uniform weight, size, shape* Have each egg in the dozen as nearly alike in weight as possible Total weight of the dozen should be between 21 and 27 ounces. Size and shape should be carefully observed for uniformity.

Exhibition Egg Score Card

Points	Perfect Score	Explanation of Cuts
Size	20	All eggs must weigh from 21 to 28 ounces to the dozen, depending on division Two points will be cut for each ounce over division Three points will be cut for each ounce under division limits
Uniformity of size	10	All eggs should be the same size One-half point will be cut for each egg varying from the average weight
Uniformity of shape	15	All eggs should be the same shape From ¼ to 1 point will be cut for each egg varying from the average shape
Uniformity of color	20	All eggs should be the same color From ½ to 1 point will be cut for each egg that is not chalk white, and from ¼ to 1 point will be cut for each brown shelled egg varying from the average color
Shell texture	25	All eggs should have the best shell texture From ¼ to 1 point will be cut for each egg where the shell is ridged ¼ to 1 point will be cut for each egg where the shell is wrinkled ½ to 1 point will be cut for each egg where the shell tip is weak ¼ to 1 point will be cut for each egg where the shell has rough deposits ¼ to ½ point will be cut for each egg with a porous shell
Condition of shell	10	¼ to ½ point will be cut for each shiny egg without bloom ¼ to 1 point will be cut for each dirty egg ¼ to ½ point will be cut for each stained egg
Total	100	

Disqualifications Entries containing broken eggs will be allowed in competition, but each broken egg will be cut 8 points

Egg Score Card

Entry No.________________ Date________________

Name________________Address________________County________________

Class________________Color________________Final Score________________

Points	Perfect Score	Cuts	Final Score
A Interior quality	60		
Grade AA No cuts			
Grade A Cut 1 point for each A			
Grade B Cut 2 points for each B			
Grade C Cut 5 points for each C (incl small blood and meat spots)			
Entry Disqualifications (a) Inedible eggs, including large blood or meat spots (b) Egg or eggs showing signs of incubation or germ development			
B Exterior quality	40		
1 Size (dozen) Cut 6, if average weight is within one oz above or below class wt , cut 12, if average weight is within two oz If more than 2 oz above or below class weight, disqualify entry	12		
2 Uniformity of size and shape Cut ½ to 1 point for each egg varying in size or shape from average No cuts in class weight range Large, 24 to 27 oz Medium, 21 to 23 oz Pullet, 18 to 20 oz	12		
3 Uniformity of color ½ for cream or tint in white eggs, or varying from average color in brown eggs	8		
4 Shell texture—condition (cleanliness) 1 for each leaker or smashed egg ¼ for dirty or stained egg ¼ for rough shell, porous shell, blind check	8		
Total	100		

(Department of Poultry Husbandry, Cornell University, Ithaca, New York)

2 *Uniform color* Each egg in an entry should be as nearly alike in color as possible Eggs should be graded for color under daylight conditions Avoid variations in shade of brown eggs or tints in white eggs, as much as possible

3 *Clean shells and good shell texture* Eggs should be clean and must show no evidence of having been cleaned Eggs showing rough areas, wrinkles, ridges, and other evidences of ir regular shell texture, should not be selected *Note* It may not be possible in all cases to examine for interior egg quality of the egg before a candler In such a case, aim to have the best of exterior quality and select the freshest eggs available for ex hibiting Keep these eggs under desirable holding tempera tures (45–60° F) and moisture before sending them to the show If eggs are candled, however, observe the following points

a Sound shelled eggs The shell condition can be seen only by candling Eggs selected should be sound and 'finely pored," and free from fine checks, blind and body checks, or large thin areas

b Small air cell A small air cell (less than ⅛ inch in depth) is an indication of good handling of the egg under desirable temperatures and moist surroundings which prevent evapora tion

c Dimly visible yolk The outline of the yolk should be only dimly visible, and not rapid moving No germ develop ment should have occurred and eggs (if fertile) should be gath ered frequently, and kept at temperatures below 60 degrees

d Firm, clear white The white should be clear and firm, as indicated by a yolk which moves slowly when the egg is can dled No foreign objects should be present in the white, such as meat spots

Packing and shipping eggs Protect eggs to be carried or shipped to the show by—

1 Packing the eggs with small end down to maintain the air cell position

2 Wrapping each egg with ample packing material to insure firmness of pack and protection

3 Using a firm, sound container such as a regular shipping box or market basket to protect eggs from cracking

4 Marking the package plainly with such cautions as EGGS and FRAGILE if shipping by express or parcel post

5 Marking plainly the name, address, and class entered by exhibitor

Score card. The score card used in judging eggs at the Iowa State College Show is shown here

Score Card

Exhibit No.____________ Color____________

Class____________

Score____________

Points	Perfect		Actual
Weight		22	
Exterior appearance		30	
A Uniformity of size	6		
B Uniformity of shape	6		
C Uniformity of color	9		
D Cleanliness and texture	9		
Interior appearance		48	
A Shell soundness	6		
B Air cell	6		
C Yolk	18		
D White	18		
Total		100	

Name____________ Town____________

BABY CHICK SHOWS

In 1926 the Poultry Department of the Kansas State Agricultural College introduced a new type of poultry show This was the baby-chick show Other states have followed the example

set by Kansas, and now the baby chick and turkey poult sections of poultry shows are very popular Standards for judging baby chicks are now in the *American Standard of Perfection*

On this page and page 457 are a score card and an explanation of cuts used in judging chicks and poults in an eastern show

Baby Chick and Turkey Poult Score Card
25 Chick Entry, 10 Turkey Poult Entry

Points	Perfect Score	Explanation of Cuts
Vigor	30	¼ to 1 point is deducted for lacking substance in handling ⅛ to ½ point is deducted for lacking alertness and lacking full, bright eyes ⅛ to ½ point is deducted for shanks small and dried up
Condition	30	⅛ to 1 point is deducted for each imperfectly healed navel ⅛ to 1 point is deducted for each pasty vent ⅛ to 1 point is deducted for each chick showing signs of a sticky hatch
Uniformity of color	20	⅛ to ½ point is deducted for each chick whose down color varies from the average of the entry ½ point is deducted for each chick having leg color other than standard for the breed and variety
Uniformity of size	10	½ point is deducted for each chick varying in size from the average entry
Weight	10	Two pounds is considered minimum weight for an entry of 25 chicks and one pound for 10 poults One point is deducted for every ounce the chick entry falls below this minimum, and 2 points for poults
Dead chicks		Four points are deducted from the total score of the entry for each dead chick or poult found upon arrival at the show
Total.	100	

Explanation of cuts in judging chicks. A cut of four (4) points will be made for each chick and ten (10) points for each poult showing the following

1 Type of comb not characteristic of the breed
2 Side sprig on comb of single combed breeds and varieties
3 Feathers on shanks or down between the toes of clean shanked varieties
4 Color of down or shank foreign to the breed
5 More or less than the ordinary number of toes or web footed conditions in chicks
6 Deformed chicks or poults (crooked legs, toes, neck, back, etc)

Chicks or poults should not be fed before arriving at the show All chick and poult entries will be weighed immediately upon arrival at the show No exhibitor is allowed to handle chicks or poults in his entry after they have been received at the show

Conditions eliminating chicks or poults from competition. An entry will be eliminated from competition if generally inferior and lacking breed characteristics, if showing evidence of disease, or if showing evidence of having been fed

Note All cuts made for poults will be double that made for chicks under vigor, condition, and uniformity of color and size

POULTRY MEAT SHOWS

Both live and dressed birds are often judged in competition for meat quality Until recent years not much emphasis was placed on the production of birds with high meat quality except in connection with turkeys and ducks Turkeys and ducks are grown almost entirely as meat birds

THE CHICKEN OF TOMORROW PROGRAM

During the last decade and particularly during World War II, a great deal of interest developed in the production of a better meat chicken As a result of this interest a national contest, with the slogan "The Chicken-of Tomorrow," was developed The contest was sponsored by the Great Atlantic and Pacific Tea Company, a large retail poultry distributor, in co

operation with a National Committee, a group of all-industry leaders.

Great interest in this contest has developed, and it will no doubt result in a great deal of improvement in our popular birds raised for meat production.

The National Committee has set up the following specifications for the dressed chickens (New York Style) to be developed in this contest:

1. General description. The most desirable dressed bird for meat purposes, in relation to age and size, is one that is relatively long, broad, deep, and well fleshed; with a broad, long, well-meated and rounded breast; plump and meaty legs, moderately short shanks; moderately short neck; and the entire carcass well covered with fat.

2. Body conformation. (a) Well proportioned.

(b) Back: wide, long, and flat.

(c) Keel bone: straight, parallel with back, and extending well beyond thigh and drumstick joint when the bird is suspended.

(d) Ribs: well sprung.

(e) Neck: moderately short.

3. Breast. (a) Prominent and well developed.

(b) Broad, with good depth and length.

(c) Fully fleshed throughout entire length.

4. Fleshing. (a) Fully fleshed; breast, legs, and hip joints well covered with thick layers of meat effecting a rounded conformation.

(b) Large per cent of edible meat.

(c) Soft meated and fine textured, yet reasonably firm as related to age.

5. Fat. (a) Entire carcass reasonably well covered with fat.

(b) Little or no dark meat showing through skin.

6. Legs. (a) Straight, plump, and meaty.

(b) Moderately short and sturdy.

7. Wings. Well fleshed.

8. Skin. (a) Clean, free from protruding pinfeathers, practically free from nonprotruding and especially dark pinfeathers.

(b) Bright, soft, pliable—smooth textured.

(c) Uniform in color.

Disqualifications: deformities such as.

1 Crooked or dented keel
2 Hunchback
3 Misshapen bones
4 Callouses and blisters
5 Bareback
6 Black, blue, or green color in skin

In the 1946 and 1947 preliminary contests birds were produced on the entrants' farms In the final contest, 1948, hatching eggs were sent by the entrants to a central hatchery, where they were hatched and the chicks brooded and grown at the University of Delaware Experiment Substation under identical conditions

The chickens at twelve weeks of age were dressed and judged according to the score cards on pages 460 and 461

POULTRY JUDGING CONTESTS

An interesting feature of many poultry shows is a judging contest The contestants may be poultrymen but more often they are college students, 4-H Club members, or members of high school groups or Future Farmers of America As far back as 1909 poultry judging contests were held in the United States where college students took part in competitive judging Now in at least three sections of the country, intercollegiate contests are being held annually so that a team from any college or university has the opportunity of competing in such a contest

In some contests both production and standard classes of birds are judged while in at least one contest the birds are judged on a combination basis Dressed poultry and eggs may also be included in the classes to be judged by the students The judging competition has come to be a very important part of the 4-H Club and Future Farmers of America programs Contests may begin as local community affairs in which eliminations are made, the winners going on to county, state, sectional, and national contests

When the judging is confined to live birds either four or five bird classes are used The birds are selected and placed in advance of the contest by a committee or judge It is important that the birds vary in quality in order to eliminate the possibil

Score Card No. 1

Dressed Chickens (New York Style)

	Point Value
1 Conformation, including factors effecting edible meat yield (In the final judging in the national contest, the judges may give consideration to the per cent of edible breast and leg meat in making the final awards)	
a Body well proportioned	20
b Breast broad, long, full meated, well rounded	20
c Keel bone not prominent (well covered), straight, parallel with back	10
d Thigh joint plump, full meated	10
e Drumstick (lower joint) full meated, moderately short	10
f Back wide, long, flat, well fleshed	10
2 Condition	
a Pinfeathers free from protruding pinfeathers, practically free from nonprotruding and especially dark pinfeathers	5
b Skin bright, soft, pliable, smooth textured, uniform in color	5
c Little or no dark meat showing through skin	5
d Entire carcass well covered with fat (age and size considered)	5

Disqualifications

1. Crooked or dented keel
2. Hunchback
3. Misshapen bones
4. Callouses and blisters
5. Bareback
6. Black, blue, or green color showing through skin
7. Misrepresentation, falsification, use of artificial practices (except lights), such as plumping, hormones, etc.

Score Card No. 2
Economy of Production
Live Chickens

	Point Value
1. Egg production rate of parent flock (or flocks if parents come from different flocks) This is to be determined by production January 1 to June 1 (Divide total number of eggs by number of hens in flock January 1)	25
2. Per cent hatch of all eggs set. Individual eggs shall weigh at the rate of not less than 23 ounces per dozen or more than 28 ounces per dozen.	10
3 Chicks raised to 12 weeks of age (per cent mortality and culls)	10
4 Pounds of feed per pound of chicken at 12 weeks	15
5 Average live weight at 12 weeks of age (empty crop)	15
6. Per cent of rapid feathering at 10 days of age and completeness and uniformity of feathering at 12 weeks (freedom from pin-feathers). . ..	10
7. Uniformity of size (weight)	10
8. Uniformity of type and color....	5

Disqualifications

Misrepresentation, falsification, use of artificial practices (except lights) or materials such as hormones, etc.

This winning poultry judging team placed first, third, and fourth as individuals in the 25th Eastern Intercollegiate Poultry Judging Contest

ity of a mere guessing contest A well trained student judge should be able to recognize the differences between birds in the majority of cases On the other hand the classes should not be set up so that the correct placings are obvious Usually the classes tend to be too easy rather than too difficult.

Awards and prizes The method of grading the placings of the contestants is usually set forth in the rules governing the contest or is decided upon in time so that all contestants may become familiar with the method adopted The method that has been used very generally and one that has proven very satisfactory is a plan whereby all the possible placings that can be made in a four or five bird class are worked out in advance Table 70 shows all the possible placings in a four bird class with the corresponding scores and Table 71 shows the placings in a five bird group

Prizes include lots of 25 to 100 baby chicks various items of poultry equipment medals loving cups, cash, and scholarships amounting to $250 Prizes are usually donated by commercial organizations and public spirited persons who have a direct interest in better agriculture

TABLE 70 ALL POSSIBLE COMBINATIONS OF PLACINGS AND RESULTING SCORES WITH FOUR INDIVIDUALS IN A CLASS

GRADE SHEET

The column on the right shows an approximate score

1 2 3 4	100	or 100
1 2 4 3	84	80
1 3 2 4	84	80
1 3 4 2	68	70
1 4 2 3	68	70
1 4 3 2	50	50
2 1 3 4	84	80
2 1 4 3	68	70
2 3 1 4	68	70
2 3 4 1	50	50
2 4 1 3	50	50
2 4 3 1	32	30
3 1 2 4	68	70
3 1 4 2	50	50
3 2 1 4	50	50
3 2 4 1	32	30
3 4 1 2	32	30
3 4 2 1	16	20
4 1 2 3	50	50
4 1 3 2	32	30
4 2 1 3	32	30
4 2 3 1	16	20
4 3 1 2	16	20
4 3 2 1	0	0

(Department of Poultry Husbandry, Cornell University, Ithaca, New York)

The value of judging contests. There are several benefits which may result from participation in judging contests Real educational value may be derived from the training received in preparation for the contest Those who are fortunate enough to be chosen to compete on a judging team do a great deal of extra work in the intensive training for the team In this work the student learns to make decisions and to place a definite value on quality. Since the contest is often held at a leading poultry show, it provides an opportunity for contestants to see the finest birds that are produced in the country and the results of the methods of fitting and exhibiting them

Another important feature of the contest is that it provides an opportunity for students, 4-H Club boys and girls, and other

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1 2 4 3	84	80
1 3 2 4	84	80
1 3 4 2	68	70
1 4 2 3	68	70
1 4 3 2	50	50
2 1 3 4	84	80
2 1 4 3	68	70
2 3 1 4	68	70
2 3 4 1	50	50
2 4 1 3	50	50
2 4 3 1	32	30
3 1 2 4	68	70
3 1 4 2	50	50
3 2 1 4	50	50
3 2 4 1	32	30
3 4 1 2	32	30
3 4 2 1	16	20
4 1 2 3	50	50
4 1 3 2	32	30
4 2 1 3	32	30
4 2 3 1	16	20
4 3 1 2	16	20
4 3 2 1	0	0

(Department of Poultry Husbandry, Cornell University, Ithaca, New York.)

The value of judging contests. There are several benefits which may result from participation in judging contests. Real educational value may be derived from the training received in preparation for the contest. Those who are fortunate enough to be chosen to compete on a judging team do a great deal of extra work in the intensive training for the team. In this work the student learns to make decisions and to place a definite value on quality. Since the contest is often held at a leading poultry show, it provides an opportunity for contestants to see the finest birds that are produced in the country and the results of the methods of fitting and exhibiting them.

Another important feature of the contest is that it provides an opportunity for students, 4-H Club boys and girls, and other

TABLE 71 All Possible Combinations of Placings and Resulting Scores with Five Individuals in a Class

GRADE SHEET

In the upper left hand column is the perfect score of 100 points, or 1, 2, 3, 4, 5 If a member should place the exhibits 3, 4, 2, 1, 5, we find in the first column his score to be 50 points Any combination can be located quickly and the score found in the same way

1 2 3 4 5	100	2 1 3 4 5	90	3 1 2 4 5	80	4 1 2 3 5	70
1 2 3 5 4	90	2 1 3 5 4	80	3 1 2 5 4	70	4 1 2 5 3	60
1 2 4 3 5	90	2 1 4 3 5	80	3 1 4 2 5	70	4 1 3 2 5	60
1 2 4 5 3	80	2 1 4 5 3	70	3 1 4 5 2	60	4 1 3 5 2	50
1 2 5 3 4	80	2 1 5 3 4	70	3 1 5 2 4	60	4 1 5 2 3	50
1 2 5 4 3	70	2 1 5 4 3	60	3 1 5 4 2	50	4 1 5 3 2	40
5 1 2 3 4	60	1 3 2 4 5	90	2 3 1 4 5	80	3 2 1 4 5	70
5 1 2 4 3	50	1 3 2 5 4	80	2 3 1 5 4	70	3 2 1 5 4	60
5 1 3 2 4	50	1 3 4 2 5	80	2 3 4 1 5	70	3 2 4 1 5	60
5 1 3 4 2	40	1 3 4 5 2	70	2 3 4 5 1	60	3 2 4 5 1	50
5 1 4 2 3	40	1 3 5 2 4	70	2 3 5 1 4	60	3 2 5 1 4	50
5 1 4 3 2	30	1 3 5 4 2	60	2 3 5 4 1	50	3 2 5 4 1	40
4 2 1 3 5	60	5 2 1 3 4	50	1 4 2 3 5	80	2 4 1 3 5	70
4 2 1 5 3	50	5 2 1 4 3	40	1 4 2 5 3	70	2 4 1 5 3	60
4 2 3 1 5	50	5 2 3 1 4	40	1 4 3 2 5	70	2 4 3 1 5	60
4 2 3 5 1	40	5 2 3 4 1	30	1 4 3 5 2	60	2 4 3 5 1	50
4 2 5 1 3	40	5 2 4 1 3	30	1 4 5 2 3	60	2 4 5 1 3	50
4 2 5 3 1	30	5 2 4 3 1	20	1 4 5 3 2	50	2 4 5 3 1	40
3 4 1 2 5	60	4 3 1 2 5	50	5 3 1 2 4	40	1 5 2 3 4	70
3 4 1 5 2	50	4 3 1 5 2	40	5 3 1 4 2	30	1 5 2 4 3	60
3 4 2 1 5	50	4 3 2 1 5	40	5 3 2 1 4	30	1 5 3 2 4	60
3 4 2 5 1	40	4 3 2 5 1	30	5 3 2 4 1	20	1 5 3 4 2	50
3 4 5 1 2	40	4 3 5 1 2	30	5 3 4 1 2	20	1 5 4 2 3	50
3 4 5 2 1	30	4 3 5 2 1	20	5 3 4 2 1	10	1 5 4 3 2	40
2 5 1 3 4	60	3 5 1 2 4	50	4 5 1 2 3	40	5 4 1 2 3	30
2 5 1 4 3	50	3 5 1 4 2	40	4 5 1 3 2	30	5 4 1 3 2	20
2 5 3 1 4	50	3 5 2 1 4	40	4 5 2 1 3	30	5 4 2 1 3	20
2 5 3 4 1	40	3 5 2 4 1	30	4 5 2 3 1	20	5 4 2 3 1	10
2 5 4 1 3	40	3 5 4 1 2	30	4 5 3 1 2	20	5 4 3 1 2	10
2 5 4 3 1	30	3 5 4 2 1	20	4 5 3 2 1	10	5 4 3 2 1	0

(Department of Poultry Husbandry, Cornell University, Ithaca, N Y)

groups, as well as coaches, from many parts of the country to get together and discuss questions of mutual interest.

SUGGESTIONS AND QUESTIONS

1 Make a list of some of the great poultry shows and exhibitions How does a production show differ from a Standard show?

2. Have a contest among the boys in the FFA in fitting and showing birds for exhibition

TABLE 71 ALL POSSIBLE COMBINATIONS OF PLACINGS AND RESULTING SCORES WITH FIVE INDIVIDUALS IN A CLASS

GRADE SHEET

In the upper left hand column is the perfect score of 100 points, or 1, 2, 3, 4, 5 If a member should place the exhibits 3, 4, 2, 1, 5, we find in the first column his score to be 50 points Any combination can be located quickly and the score found in the same way

1 2 3 4 5	100	2 1 3 4 5	90	3 1 2 4 5	80	4 1 2 3 5	70
1 2 3 5 4	90	2 1 3 5 4	80	3 1 2 5 4	70	4 1 2 5 3	60
1 2 4 3 5	90	2 1 4 3 5	80	3 1 4 2 5	70	4 1 3 2 5	60
1 2 4 5 3	80	2 1 4 5 3	70	3 1 4 5 2	60	4 1 3 5 2	50
1 2 5 3 4	80	2 1 5 3 4	70	3 1 5 2 4	60	4 1 5 2 3	50
1 2 5 4 3	70	2 1 5 4 3	60	3 1 5 4 2	50	4 1 5 3 2	40
5 1 2 3 4	60	1 3 2 4 5	90	2 3 1 4 5	80	3 2 1 4 5	70
5 1 2 4 3	50	1 3 2 5 4	80	2 3 1 5 4	70	3 2 1 5 4	60
5 1 3 2 4	50	1 3 4 2 5	80	2 3 4 1 5	70	3 2 4 1 5	60
5 1 3 4 2	40	1 3 4 5 2	70	2 3 4 5 1	60	3 2 4 5 1	50
5 1 4 2 3	40	1 3 5 2 4	70	2 3 5 1 4	60	3 2 5 1 4	50
5 1 4 3 2	30	1 3 5 4 2	60	2 3 5 4 1	50	3 2 5 4 1	40
4 2 1 3 5	60	5 2 1 3 4	50	1 4 2 3 5	80	2 4 1 3 5	70
4 2 1 5 3	50	5 2 1 4 3	40	1 4 2 5 3	70	2 4 1 5 3	60
4 2 3 1 5	50	5 2 3 1 4	40	1 4 3 2 5	70	2 4 3 1 5	60
4 2 3 5 1	40	5 2 3 4 1	30	1 4 3 5 2	60	2 4 3 5 1	50
4 2 5 1 3	40	5 2 4 1 3	30	1 4 5 2 3	60	2 4 5 1 3	50
4 2 5 3 1	30	5 2 4 3 1	20	1 4 5 3 2	50	2 4 5 3 1	40
3 4 1 2 5	60	4 3 1 2 5	50	5 3 1 2 4	40	1 5 2 3 4	70
3 4 1 5 2	50	4 3 1 5 2	40	5 3 1 4 2	30	1 5 2 4 3	60
3 4 2 1 5	50	4 3 2 1 5	40	5 3 2 1 4	30	1 5 3 2 4	60
3 4 2 5 1	40	4 3 2 5 1	30	5 3 2 4 1	20	1 5 3 4 2	50
3 4 5 1 2	40	4 3 5 1 2	30	5 3 4 1 2	20	1 5 4 2 3	50
3 4 5 2 1	30	4 3 5 2 1	20	5 3 4 2 1	10	1 5 4 3 2	40
2 5 1 3 4	60	3 5 1 2 4	50	4 5 1 2 3	40	5 4 1 2 3	30
2 5 1 4 3	50	3 5 1 4 2	40	4 5 1 3 2	30	5 4 1 3 2	20
2 5 3 1 4	50	3 5 2 1 4	40	4 5 2 1 3	30	5 4 2 1 3	20
2 5 3 4 1	40	3 5 2 4 1	30	4 5 2 3 1	20	5 4 2 3 1	10
2 5 4 1 3	40	3 5 4 1 2	30	4 5 3 1 2	20	5 4 3 1 2	10
2 5 4 3 1	30	3 5 4 2 1	20	4 5 3 2 1	10	5 4 3 2 1	0

(Department of Poultry Husbandry Cornell University Ithaca N Y)

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SUGGESTIONS AND QUESTIONS

1 Make a list of some of the great poultry shows and exhibitions How does a production show differ from a Standard show?

2 Have a contest among the boys in the FFA in fitting and show ing birds for exhibition

3 Stage a baby chick and egg show as a class project sometime during April or May Local merchants and poultrymen are often glad to donate prizes

4 What are the benefits to be derived from exhibiting eggs, chicks or mature birds?

5 What dangers are involved in showing mature birds? What can be done to avoid the dangers?

6 Visit poultry shows or egg shows held in your own or nearby communities

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CHAPTER 14

Diseases and Parasites of Poultry

OF ALL the domestic animals poultry suffers the greatest losses from disease The birds generally eat from the ground, and many flocks are kept on a small range These conditions favor the rapid spread of disease and the increase in parasitism Frequently the losses are great because the disease makes so much headway before the flock owner starts to check it Sometimes it is due to the fact that the wrong treatment is used, in which case still more damage occurs

The various diseases are not easy to tell apart because symptoms are similar in many cases This is particularly true of respiratory diseases For instance, if nasal discharges, watery eyes, sneezing, coughing or other bronchial symptoms are noticeable it could be laryngotracheitis coryza infectious bronchitis or even Newcastle disease A laboratory examination will probably be necessary in order to determine definitely what disease is present

Means for preventing excessive losses from many of the infectious and parasitic diseases are at hand Successful control of diseases in poultry is dependent upon an early, correct diagnosis Therefore, if disease strikes your flock, find out what the disease is and then start control measures immediately You will find that some diseases do not yield to any treatment, in which case it will be necessary to dispose of the flock Other diseases respond to treatment, cutting the losses substantially or, in some cases reducing the death loss to practically nothing But before you can attack a disease intelligently you must know definitely what it is

Normally a flock owner should expect some death loss in the laying flock. This loss ought not to exceed 10 per cent, however, and should be more or less scattered throughout the year. When a bird dies occasionally there is no need for alarm. When a number of birds show the same symptoms and mortality is heavier, however, it is time to have a laboratory diagnosis made at once.

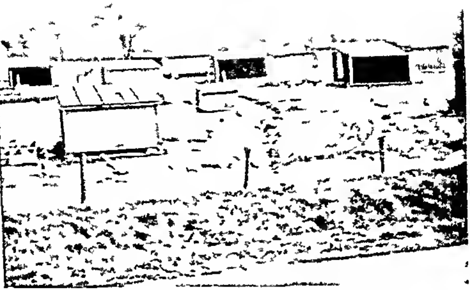
IMPORTANCE OF AN ACCURATE DIAGNOSIS

When an unusual number of deaths occur in the flock, the poultryman must take steps to protect the remaining birds. The making of an accurate diagnosis is the first step in the control of any disease.

The making of a correct diagnosis frequently requires much skill and experience. It requires a thorough knowledge of the nature of diseases in general, a knowledge of the specific poultry diseases and a knowledge of the history, symptoms and the post mortem findings of the outbreak under investigation. Poultrymen must be repeatedly cautioned to submit all of the available history about the flock from which the birds are taken for laboratory specimens. Too frequently the specimens submitted for examination do not reveal lesions sufficient in number, type, extent or degree of development to warrant making more than a tentative diagnosis. The history should take into consideration such things as the size of the affected flock, the age of the affected birds, the duration of the trouble in the flock and the rapidity with which the trouble had spread through the pens and from one pen or house to another.

The symptoms include the behavior of the affected birds, whether they eat or not, whether there are any changes in appearance or behavior, how long the affected birds remained sick and whether most of the affected birds die or recover. The post mortem examination reveals the changes that have occurred in the body as a result of the disease. The changes frequently are difficult to recognize.

Sometimes a diagnosis may be made by studying the history and the symptoms alone, but in many cases it is necessary to depend also on post mortem examination. Even autopsy examination will not always clear up the diagnosis and one needs to resort to microscopic and intricate bacteriological and chem



Poor range conditions The houses are too close together, with no pasture available to chicks. Notice the erosion of the soil All of these factors spell out conditions favorable for disease development

ical tests When only a single bird is available, all of the examinations may fail If there are several diseased birds available and, particularly, if various stages of the disease are represented in them an experienced pathologist can usually make a fairly definite diagnosis

It is a common experience to find more than one disease in a flock at the same time If this fact is not taken into consideration one of the diseases may be overlooked, and the treatment or control methods recommended will be likely to fail to clear up the difficulty The accuracy of the diagnosis will depend largely upon the doctor's knowledge of poultry diseases Experience has shown that a complete history, a careful study of symptoms and a thorough post mortem examination are necessary in order to arrive at an accurate diagnosis

The personal visit to a diagnostic laboratory For diagnosis

the most satisfactory results can be obtained by the personal visit in which the poultryman brings typically affected live and dead specimens to the local veterinarian or to one of the state diagnostic laboratories which have been established in most of the states. In this way a complete, adequate history of the case can be obtained. The importance of the history of the case cannot be overemphasized, because in certain instances a diagnosis can be based upon the history alone. The poultryman also has the opportunity to watch the post mortem and physical examinations performed on his birds and can discuss the case as the examinations are being made.

In most cases, a definite diagnosis can be established on the basis of the examinations, and recommendations can be made to the poultryman for the handling of this particular condition on his farm. There are some cases that require additional laboratory examinations which take more time, but in general these are the exception rather than the rule. In most of these cases, however, preliminary control measures can be established on a presumptive diagnosis until a definite diagnosis can be made. In this way, little or no time is wasted in controlling the particular disease at hand.

Shipping specimens for diagnosis. If a personal visit cannot be made to a diagnostic laboratory, it will be necessary to ship specimens. Live birds are more satisfactory than dead ones for disease examination. It is important that a poultryman select typically affected birds to be shipped for examination. If birds have colds they should not be shipped by a common carrier. Select two or three mature birds or one half dozen younger birds. When shipping live birds the box should be strong. Ship by express, and prepay the charges. Furthermore, they should be shipped so that they will not arrive on Saturday, Sunday, or holidays.

In some cases, it might be necessary to ship the dead fowl. This is unsatisfactory, especially in the summertime because so much decomposition develops in the bird that examination may be practically impossible. When dead birds are submitted they should be put in a metal container which is surrounded by ice and sawdust in another metal container. These containers are returned to the sender after the examination. Again all shipments should be made express prepaid. The results of

these examinations are usually sent to the poultryman by mail Frequently, however, if the situation warrants, he might be called by telephone

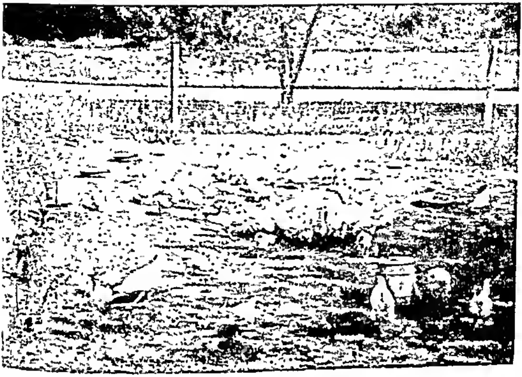
As already indicated, a complete history should be written in a letter which is attached to the container in which the specimens are sent to the laboratory Some of the information to be supplied is as follows name and address of the flock owner, number of birds in the shipment, age and breed of the birds, number of birds in the home flock, number of birds that have died since the disease started, length of time the disease has been in the flock and effect on egg production or other performance, the source of the chicks, any symptoms such as droopiness, bronchial disturbances, diarrhea, nervous manifestations, and the like, feeds and feeding system used, together with any changes that might have been made recently, type of houses, general management of the flock, and any treatment that has been given

SANITATION

The principles of hygiene, sanitation, and disease prevention should be understood by everyone who tries to keep animals under domestication Sanitation refers to conditions that promote health and prevent disease It not only refers to cleanliness but to the construction of buildings in such a way as to prevent dampness and draft, the construction of feeding and watering arrangements so that these are kept free of contamination, and to the provision for sufficient room in buildings and pens for the number of birds kept.

Good sanitary conditions tend to retard and sometimes to prevent the spread of diseases Poor sanitary conditions, on the other hand, favor the spread of disease both by devitalizing the birds and thus lowering their natural resistance and by providing favorable conditions for the preservation and propagation of disease germs Sunlight and drying are the two natural disinfectants Disease germs thrive best in damp and dark places These facts should always be kept in mind as primary considerations in a sanitary program

Ways of introducing disease into a flock. All diseases due to germs, viruses, or parasites come directly or indirectly from



Bare ground and improper equipment make it difficult to maintain proper sanitation.

other diseased birds. A good sanitary program begins with the prevention of disease introduction. The disease may be introduced into a flock in one or more of many ways. The most common are as follows:

Through eggs. Since disease may be introduced through eggs, they should be obtained from flocks free from disease. Pullorum disease and fowl typhoid are the common examples. It is suspected that this may also be true for some other diseases such as Newcastle disease and leucosis. Eggs from an outside flock can spread disease through chicks in the incubator. This is one of the dangers of custom hatching.

By chicks. Pullorum disease may be introduced by baby chicks. All chicks coming from outside sources should be brooded separately from chicks originating on the farm. Epidemic tremors, bronchitis, and other respiratory troubles may also be introduced by baby chicks as well as in other ways.

By adult stock. Mature birds may introduce a number of diseases. A bird may be in the early stages of the disease and

not show symptoms until it has been on the farm for some time or until the birds may have recovered from the disease which has left some of them carriers. Hence, newly acquired adult stock should be quarantined.

By human visitors. Visitors may bring disease onto the premises. This is particularly true if they have handled sick birds on another farm the same day. Indiscriminate wandering of visitors through all pens should not be permitted. Of course, the poultryman himself might carry disease from one pen to another in a similar fashion.

By animal carriers. Dogs, cats, rats, mice, and wild birds have been incriminated in introducing and spreading disease. These animals themselves may not be diseased but merely carry the disease agents between farms and pens. Hence, the control of vermin and exclusion of other animals from the pens should be practiced.

By insects. Mosquitoes and blood-sucking flies may spread diseases and other insects may spread parasites. The extent to which insects spread disease between farms and pens is not known, but the importance of insects as a means of spreading disease cannot be ignored. Hence, insect life should be reduced as much as possible by maintaining proper sanitation on the farm.

Through equipment. Equipment may carry disease-producing agents. This is particularly true of crates returned from market. It is best not to use shipping crates for any work around the farm. Birds that are known to be sick should not be handled in crates that are used for the work about the plant.

If there is disease on the farm, any equipment such as feeders or waterers should not be moved from one pen to another until they have been thoroughly disinfected.

The regular feed sacks ordinarily do not constitute a danger in the spread of disease unless such sacks have been used to carry diseased birds or unless the sacks come from a farm which has disease, in which case droppings or other filth might adhere to the sacks. In any event, danger from this source can be eliminated if the sacks have had proper care.

Through drinking water. The spread of disease through the drinking water is often suspected and probably does take place

at times Adding a disinfectant to the water is practiced, but its real value is questionable The important thing is to provide watering equipment that can be kept clean

PREVENTION OF DISEASE

An ounce of prevention is worth a pound of cure ' In no place is this old adage more true than when dealing with disease A good, general understanding of the ways in which disease is spread, combined with an application of this knowledge is perhaps the best way of preventing disease

Stock It has been pointed out that many diseases are introduced through eggs, chicks, or mature birds Therefore the important item when getting new stock is to be sure that it comes from a clean flock The general stamina and health of the birds are very important

Proper housing The stock must be given a chance by being properly protected This means good houses So far as disease is concerned, sudden changes of temperature, very low and very high temperatures, dampness and drafts are the principal considerations These, however, can be controlled by proper construction and management

Ranges and yards Some diseases may persist in the soil for considerable periods of time Rotation of ranges and yards is a desirable practice Both ranges and yards should have periods of time during which no birds are kept on them Cropping unused ranges and yards assists in keeping them safe for birds

Feeding The birds should be given proper rations in order to enable them to grow and produce satisfactorily Only feeds of good quality should be used The ration must contain the correct amounts of the various ingredients in order to provide for the requirements of the birds Feeds of poor quality may contribute to the mortality in the flock, especially if they are deficient and produce such conditions as rickets vitamin A-deficiency or perosis

Management Any part of the management which is not favorable might contribute towards losses Overcrowding may result in toe picking feather pulling and other forms of cannibalism When disease once gains an entrance into an overcrowded pen of birds it usually spreads rapidly, and frequently

Proper cleaning of the house will help to prevent disease.

the mortality is heavier than is ordinarily experienced.

Cleaning. Some diseases are spread through droppings, others through discharges from the mouth, nose, and eyes. Hence, the food and drink may easily become contaminated through the habits of the birds. Therefore, the houses, feeders, waterers, and other equipment should be cleaned frequently, especially when disease is present.

Droppings. The dropping boards should be screened. These, as well as the roosts, should be scraped frequently. When dropping boards are not used, that part of the floor under the roost should be screened. During warm weather, the dropping boards and roosts should be treated for mites. The manure should not be allowed to accumulate on the farm. If it must be stored, it should be kept in a shed which will protect it from rain and which is vermin- and insect-proof. When used on fields, the manure should be spread in a thin layer and should not be applied to land that will be used for birds later.

Litter. The litter should be deep and dry. A deep litter is more likely to remain dry longer than a shallow one. The watering equipment should be such as to keep the litter dry. Litter needs to be changed frequently more because it has become damp than because it is dirty.

Vermin control. Since diseases can be introduced and spread by animals, wild birds, and insects, keeping these under control is extremely important. Hence, a constant fight should be waged against rats, mice, lice, and mites.

Segregation of birds. Young chicks should be brooded at a distance from the old stock, and they should be kept separate as much as possible. If both the young and old stock must be cared for by the same person, special precautionary measures

should be exercised when going from one to the other When new stock is added to the flock or when birds that have been away are returned to the farm, they should be quarantined for a period of time to make sure that they are not carriers of disease or infection Unhealthy birds should be removed at any time In the early stages of an outbreak of disease, affected birds should be removed from the pens and isolated or killed It is very important that a prompt diagnosis of the disease be obtained in order that proper steps can be taken to control the trouble Ordinarily, treating sick birds is not worth while If a large proportion of the birds become affected, the pens should be quarantined The person taking care of such pens should again exercise special precautionary measures

Disposal of dead birds Sanitary disposal of birds that die is always a problem, particularly where large numbers of poultry are kept On farms where poultry is slaughtered, the blood, feathers, and dressing waste create an additional disposal problem Likewise, for hatcherymen, eggs that fail to hatch require disposal

On many farms, birds that die are burned or buried On some, the carcasses are tossed onto the manure pile or into the pig pen on others, the dead birds are carried to the back pasture or dumped into the wood lot All of these methods, however, have certain limitations and objections

Burying each bird individually requires considerable time to get the carcass deep enough to prevent animals from uncovering it Furthermore, during a large part of the year the ground may be frozen, making impossible this method of disposal

Burning the carcasses is a more sanitary method than burying and one that can be used in all seasons Its chief disadvantage is the difficulty in doing a complete job of burning even with incinerators constructed especially for the purpose

A *disposal pit* probably is the most practical way to get rid of dead birds on most farms Dead birds are dropped down a tile into a covered pit below Not only is considerable labor saved in the disposal of birds, but the method is sanitary and can be used during all seasons No animals can get at the decaying carcasses No lime or other material is needed to aid decomposition

Location of the pit Convenience, distance from the water

A poultry disposal pit

supply, type of soil, and slope of the land determine the best location for a disposal pit. For greatest convenience, the pit should be near the door of the laying house. While soil is an excellent filter, the pit should not be near the water supply. If possible, the pit should be below the level of the water supply and at least 100 feet away

Sandy or gravelly soil permits subsurface drainage and, in general, is preferred to a heavier soil Sandy and gravelly soils tend to cave badly however Shale near the surface of the ground, with gravel toward the bottom, would be ideal and gives some advantage for drainage as well as resistance to caving

The pit should be so placed that prevailing winds will not carry odors to the farm house Odors, if not prevented entirely will be unnoticed if at least 12 inches of dirt is put over the pit and if the tile has an airtight cover

The slope of the land should be considered so that surface drainage will not cause the pit to fill with water and waterborne soil The dirt over the pit should be higher than the surrounding area and sloped to provide surface drainage away from the pit If the pit is on a slope, a diversion ditch is desirable to prevent water from running into the pit

Size of the pit Some pits have been too small to accommodate the expected loss of birds. With a shallow pit, the rate of decomposition is slowed during the winter months The deeper the pit, the more rapid is the decomposition Pits usually become a "catchall" for all decayable waste on the farm, such as garbage, poisoned rats, offal from butchering, and eggs that fail to hatch Egg shells from the hatchery do not decompose and would take up too much space in the pit Fifty cubic feet of disposal space is suggested for each 1,000 birds A pit

4 feet deep, 4 feet wide, and 4 feet long would provide more than this amount of space

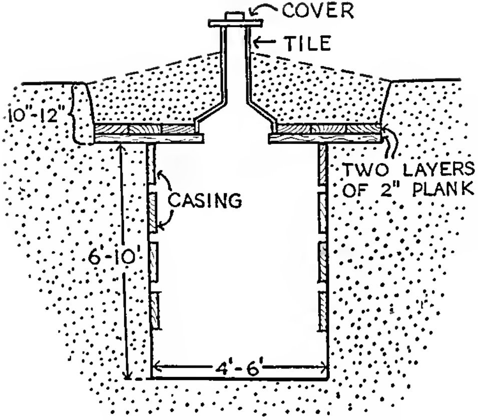
The best pit will be at least three times the space required It is impractical to have a pit less than 6 feet deep Otherwise, the rate of decomposition is too slow during the winter months Digging is inconvenient in pits less than 4 or 5 feet wide If it is much wider than this, extra supports are needed Where larger pits are desired, they should be built from 4 to 5 feet wide and long enough to provide the necessary space In these longer pits, tiles through which to drop the birds may be placed every 6 to 8 feet

Construction of the pit Dig a hole from 4 to 6 feet in diameter and from 6 to 10 feet deep Make the top of the hole at least 2 feet wider on all sides and extend this greater diameter for at least 1 foot below the surface of the ground This provides a shoulder or ledge to support the cover Use casing to prevent caving Cover the pit with two layers of 2 inch plank or heavier material, lay the top layer at right angles to the first layer Cut a hole in the center of the cover and place an 8 inch or larger tile over this (bell end down) Then add from 12 to 18 inches of dirt around the cover, sloping it to provide surface drainage away from the pit An inverted can or pail, or a flat board, may be used as a fly tight cover for the tile

Properly constructed, a pit should last several years and care should be taken to prevent disappointments Best results have been obtained when the cover for the pit has extended well beyond the edge A wide support like this helps to prevent the side walls from caving A cover below the frost line reduces the damage to the side walls from freezing and thawing

Greater permanency will be obtained if the cover to the pit is of concrete Wood if used, should be treated with a preservative such as carbolineum or creosote The material used for the covers should be strong enough to prevent a break through should a truck or tractor be driven over it

When the pit is filled a new one is dug To reduce the labor of excavating the pit, some poultrymen have used bulldozers Others suggest the use of dynamite when digging becomes difficult. A number of poultrymen suggest the use of tile larger



Construction details for a poultry disposal pit.

than 8 inches in diameter to permit handling incubator refuse with a shovel, or to admit turkeys and larger animals.

DISINFECTION

The reason for disinfection is the removal or destruction of disease germs. The importance of drying as a disinfecting agent has already been mentioned. Many disease germs are destroyed almost immediately when they become dry. Others will stand drying for a considerable time, but eventually all will die.

A preliminary cleaning of the pen and the equipment should precede disinfection. No disinfectant will be efficient in the presence of dirt and manure. Dirt and manure may not only protect disease germs from the disinfectant, but they may weaken it so that its germ-killing power is lost. Thorough cleaning includes scraping and soaking. Cleaning as well as

disinfecting equipment and movable parts of the house can be facilitated by having a tank large enough so that these can be immersed

Disinfectants. Many agents are used for disinfection Some times a combination of these agencies is better than a single one

Heat Heat is one of the best disinfectants but seldom can be used effectively except with small pieces of equipment Heat applied in the form of hot water or steam is far more effective than dry heat, probably because it is more penetrating The hotter the water, the more effective it is

A large blowtorch or firegun has also been used as a source of heat. While the flame is exceedingly hot, it has the disadvantage that the heat does not penetrate by merely passing the flame over the surface as is usually done and it might not kill the germs that lie under bits of dirt or manure There are also certain fire risks involved in its use

Chemicals. Chemical disinfectants are most commonly used These may be in the form of gases which are used for fumigation or in the form of solutions which are washed, sprayed, or allowed to soak into the infected surfaces

Fumigation Fumigation is effective only for spaces that are tight enough to hold gas for a reasonable time This means of disinfecting may be employed in well built buildings, but its principal use by poultrymen is for disinfecting incubators Formaldehyde gas is commonly used for this purpose

Liquid disinfectants The most effective way of applying liquid disinfectants to pens and large pieces of equipment is with a power or hand spray Small pieces of equipment can be best disinfected by soaking them in a vat Less material is required and more thorough disinfection is accomplished by soaking than when the disinfectant is applied by washing

Of the many disinfectants that might be used, the coal tar products and quicklime are the cheapest and most satisfactory for general poultry farm disinfection

Disinfecting the soil. No practical means have been devised to remove or kill disease producing agents in the soil When the range or yard becomes contaminated with germs or the eggs of parasites, one must depend only upon nature to reduce their number and to eventually kill them off This is brought about chiefly by sunlight and drying Keeping chickens off such land

will prevent recontamination Rotation of ranges and yards with cropping the land when it is not used by poultry seems to assist in the elimination of the disease producing agents

TYPICAL POULTRY DISEASES

In general the poultryman should not depend upon his own diagnosis of a disease condition He should know something about the more common poultry diseases, however, particularly as to their cause, the nature of the disease, general symptoms, and treatment and control measures

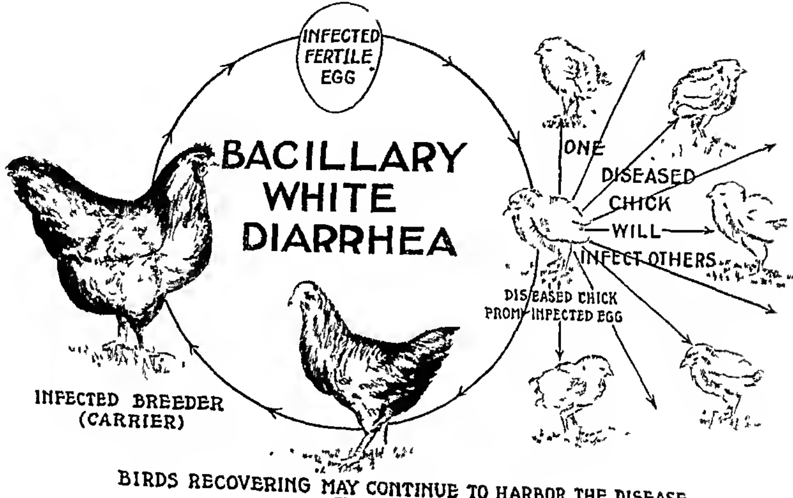
Usually diseases are grouped according to their causal agency

Bacterial diseases Many of the more common diseases of fowl are caused by bacteria Bacteria are one-celled, microscopic organisms which occur everywhere in nature Many bacteria have been isolated, but only a relatively small number cause disease

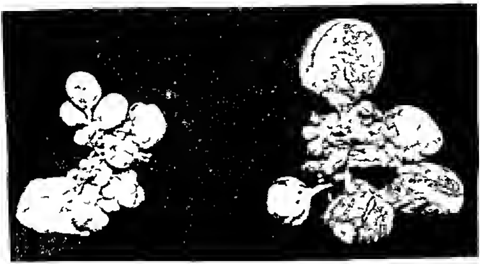
Pullorum disease Pullorum disease which is also called bacillary white diarrhea is caused by the microorganism *Salmonella pullorum* The germ occurs chiefly in the ovaries of infected hens and from these organs it passes into the eggs When infected eggs are hatched, the chicks will be infected A good many of these chicks die Some of them will survive to maturity and so perpetuate the disease When infected chicks hatch in the incubator, the pullorum germs are present not only inside their bodies but also on their skin and down After the chicks have dried a considerable amount of down and dust is circulated through the incubator by the forced-draft ventilating system Hence healthy chicks breathe the germ laden air and their lungs become infected The infected chicks also discharge large numbers of the organism by way of the droppings These infected droppings contaminate the feed, water, and litter, thus exposing healthy chicks to the disease

The most serious losses are among chicks less than two weeks of age The mortality rate will vary considerably Chilling appears to be a very important factor in determining the extent of the losses of young birds

Symptoms A post mortem examination of the chicks will show one or several abscesses in the lungs These abscesses are whitish in color and the pus does not run out when they are cut open Similar abscesses will be found in the wall of the



Life cycle of pullorum



Normal and affected ovary. Left ovary of hen infected with *Bacterium pullorum.* Notice the irregular appearance of the ova and the lack of blood vessels in their capsules. Right normal ovary of hen in laying condition. Notice the plumpness of the ova and the blood vessels in their capsules.

gizzard and in the liver. The wall of the heart may be affected similarly, and a whitish, stringy material may cover the surface of the heart.

The infection in the ovaries interferes somewhat with the function of that organ, and badly infected birds may drop in production As a rule, however, most of the birds appear normal A post mortem examination of the infected hens usually shows decided changes in the ovaries. The egg yolk becomes irregular in shape, instead of smooth and round, and some of them may be discolored Some, also, may be filled with a golden yellow oily material

Treatment and control No method of treatment has been shown to be of any value.

Control of the disease must be approached from the standpoint of the mature birds The breeding flocks must not include infected, adult birds Fortunately, infected hens can be detected by means of the agglutination test, more commonly known as the ' blood test " In order to perform this test, some blood of the infected animal and a suspension of the germs which cause the disease are needed The germs in the blood of infected animals form clumps, and the blood from normal ani-

mals does not The diagnosis is based upon whether this characteristic clumping is obtained

In the standard or tube test, blood samples are taken and sent to a laboratory for the test In this test the birds must be handled a second time in order to remove the reactors The rapid, whole blood test may be done on the farm Since the results are known in a few minutes, the birds may be held until it is known whether they are reactors

The disease can be eradicated if a persistent program is followed All new additions to the flock should be tested, and chicks should come from flocks free from pullorum disease Chicks already infected with pullorum disease cannot be cured, but the spread to healthy chicks in the incubator may be markedly reduced by formaldehyde fumigation

The routine cleaning and disinfection of brooders, poultry houses, and feeding and watering equipment is good insurance against the spread of pullorum disease as well as other illnesses of chickens Cleaning up is also an essential part of the pullorum disease control program after the reactors to the agglutination test have been removed

Avian tuberculosis Tuberculosis of fowls is a chronic, infectious disease very similar to tuberculosis in other animals It is caused by a germ which is closely related to the tubercle bacillus of man and of other animals The avian type which attacks birds is somewhat resistant to ordinary disinfectants Avian tuberculosis is chronic in nature and is generally found in old birds

Symptoms The characteristic lesions of tuberculosis are tubercles, nodules, or ulcers These are grayish or yellow tumor like swellings found in various organs or parts of the body but most prevalent in the liver, spleen, and intestines The germ rarely produces noticeable changes in other organs The liver becomes filled with hard, white lumps or nodules which may be shelled out easily The spleen shows similar nodules The intestine usually reveals a number of nodules attached to its walls When these are cut open, cavities opening into the inside of the intestine are usually found Such openings are known as ulcers The germs are usually eliminated from these ulcers in large numbers, which make the droppings of such birds very infectious


Intestine, showing nodules and ulcer, from a hen infected with tuberculosis

Some birds may show depression for a few days and die while in good flesh In these cases death is usually due to a ruptured liver Ordinarily, however, emaciation is the outstanding symptom Lameness may also accompany this loss of flesh Recovery is rare The flock mortality rate is usually high, and losses are distributed over a period of months

Treatment and control There is no treatment for affected birds The disease must be eradicated from the premises The buildings must be thoroughly cleaned and disinfected, and strict sanitary measures must be practiced If a large number of the flock is diseased the entire flock should be disposed of If only a small number of the birds are affected these may be eliminated by applying the tuberculin test and removing all reactors A continuous program of culling and weeding out of infected birds must be followed

Fowl cholera The microorganism causing fowl cholera is called *Pasteurella avicida* The germ of fowl cholera is a delicate one and lives only a short time outside the body of affected birds The germ may be present in the nasal chambers of birds that show no symptoms of disease, however The disease is highly infectious for chickens, ducks, geese, turkeys pigeons pheasants and other caged birds

Symptoms Fowl cholera has two forms In the acute form, the birds die suddenly without significant symptoms In this type the germ enters the blood stream and quickly kills the birds A post mortem examination reveals small white areas on

Cross-section and surface of liver (left and center) and of spleen (right) from a hen infected with tuberculosis.

the liver, hemorrhages on the heart and other organs, and mucoid and bloody intestinal contents.

The other type is chronic and produces respiratory symptoms. Affected birds do not die suddenly, and many may recover. The mortality may be large, particularly when complications are present and the disease spreads rapidly through the flock. A post-mortem examination reveals pus in the nasal chambers and sometimes in the air sacs. This form of the disease may begin with colds. It is accompanied by gasping and by swelling of the head and wattles.

Treatment and control: Treatment of the disease has not proved successful. Recently, however, sulfa drugs, especially sulfamerazine, sulfamethazine, and sulfaquinoxaline, have been reported effective. Dead and ailing birds should be removed immediately. Keeping the houses warm and comfortable will help the birds. Thorough disinfection and sanitary practices should be followed.

Fowl typhoid. Avian typhoid is caused by the microorganism *Shigella gallinarum*. The organism is not resistant and is readily destroyed by the common disinfectants. Warm weather favors the occurrence of the infection.

Symptoms Droopiness is often the first symptom of fowl typhoid The affected bird is listless, the head is drawn in, and the wings are allowed to sag The comb and wattles are usually pale, the feathers are ruffled, and there is a profuse greenish diarrhea The course of the disease is less acute than cholera Paleness of the comb, wattles, and membranes is al most constant The liver is enlarged, dark in color, and often possesses a characteristic greenish hue Other organs such as the liver, spleen, heart, and ovary may also be involved A low grade inflammation of the intestinal lining is usually pres ent, and the intestinal contents are slimy and yellowish

Treatment and control Treatment is generally unsatisfac tory Vaccination has sometimes been practiced Strict sani tation, however, constitutes the most effective means in con trolling the disease

Infectious coryza Infectious coryza, or a type of head cold in birds, is caused by the organism *Hemophilus gallinarum*

Symptoms The symptoms are a roupy head, swollen wat tles, a nasal discharge with an offensive odor, gasping, and sneezing Sometimes canker like lesions occur in the mouth of the birds

Treatment The use of 0 5 per cent sulfathiazole in the mash for four or five days has been found helpful by some poultrymen It is important to keep the flock comfortable and eating A program of disinfection and thorough cleaning of the premises should also be followed

Virus diseases Viruses are disease inducing agents which pass through laboratory filters fine enough to hold back the ordinary type of bacteria Since they are ultramicroscopic, their existence is shown by the ability to reproduce disease when introducing them into the body of the animal Viruses produce some of the most important poultry diseases, which are listed below

Fowl pox Fowl pox, sometimes called chicken pox, is caused by a virus Chickens and turkeys are attacked by the same agent Pigeons are affected with pox, but the causative agent is not identical with that affecting chickens

Symptoms Scabs appear on the comb, wattles, and face, and cankers appear in the mouth The scabs may involve the eye lids and cause them to swell producing a rouplike condition

Scab formation caused by fowl pox.

The opening of the windpipe may also become plugged. The disease usually causes a marked decrease in egg production, and many birds may die.

Control: Affected birds should be isolated and care taken not to spread the disease to unaffected pens. Unaffected birds should be vaccinated. Fowl-pox vaccine is likely to throw the laying birds out of production and to cause some mortality. Pigeon-pox vaccine will not materially affect egg production or harm the birds. Therefore, laying hens should be vaccinated with pigeon-pox vaccine, and the immature birds should be vaccinated with fowl-pox vaccine. Pigeon-pox vaccine gives only a temporary immunity; the fowl-pox vaccine gives lifetime immunity.

Prevention: If fowl pox has been on the farm or is in the neighborhood, vaccination is the best prevention. The growing pullets should be vaccinated with a good fowl-pox vaccine. The vaccine is usually applied either by the feather-follicle or the stick method.

In the feather-follicle method, a few feathers are removed from the leg and the vaccine is applied with a camel's-hair brush. In the stick method, a sharp-pointed knife or needle is dipped into the vaccine and the wing web is punctured. This breaks the skin and introduces the vaccine.

Infectious bronchitis. Infectious bronchitis is caused by a virus. Although the disease is more serious in chicks, it may appear as a mild disease in adults. Birds recovering from the disease may become carriers. Recovery from the disease results in immunity.

Symptoms: The affected birds gasp. The gasping may be accompanied by a rustling or gurgling noise in the windpipe. No blood is found in the windpipe as in the case of laryngotracheitis. A yellowish mucous may be found in the lower

part of the windpipe, the bronchi, or air sacs In laying birds, egg production may be greatly reduced

Treatment and control Treatment of the disease is not effective It can be eradicated from the farm by removal of all birds and proper cleaning of the premises If removal of the birds is impossible, strict quarantine is necessary

Infectious laryngotracheitis Infectious laryngotracheitis is caused by a virus Birds may be affected at any time during their life Laryngotracheitis is more likely to be found in older chickens, while infectious bronchitis is commonly seen in young birds Birds recovering from the disease may become carriers and perpetuate the disease on the farm

Symptoms In the chicks, the eyes discharge watery material which moistens the adjacent down This gives the impression that the chicks have a cold The eyelids may swell The birds are inactive, do not eat, and seek the warmer parts of the brooder In the acute form an outstanding symptom is a gasping for breath The gasping may be accompanied by a rattling noise or wheezing made by the mucous in the windpipe The birds will cough and often spit blood The windpipe may become nearly filled with a cheeselike or a reddish black material

Treatment and control Treatment has not proven very satisfactory If the disease appears among baby chicks and the number of chicks is not too large, destruction of the whole group is recommended This should then be followed by thorough cleaning and disinfection In the case of the older birds, vaccination can be practiced

Newcastle disease Newcastle disease, or pneumoencephalitis is caused by a virus This disease, as found in many parts of the world causes a very high mortality In the United States, however, the mortality is not so great.

Symptoms In young chicks, sneezing, coughing, and gasping appears suddenly and spreads rapidly The respiratory symptoms may last for a number of days Nervous symptoms may occur with or after the respiratory symptoms These take the form of a slow tremor of the head, bending and twisting of head and neck either between the legs or over the back, circling, walking backwards, or complete or partial paralysis Sometimes there are no nervous symptoms, and usually only a small

percentage of the chicks are affected Mortality is likely to be high, ranging from 20 to 90 per cent

In growing chickens the symptoms are mild and are often overlooked Nervous symptoms are usually absent, and mortality is very low, hence, the disease may be unnoticed by the poultryman

In adult birds respiratory symptoms are severe Coughing, rattling, and gasping are typical There is no nasal discharge Nervous symptoms are infrequent and often absent The symptoms usually last for from 7 to 12 days Feed consumption drops sharply, and there occurs a sudden drop in egg production to practically no eggs Normal egg production may not be reached again until three to six weeks after respiratory symptoms have ceased Many thin and soft shelled eggs are laid during this time

Treatment and control No curative agent is known The disease can be controlled by vaccination, however Segregation and quarantining of affected birds will help to prevent its spread Besides this, cleaning, sanitation, and the usual measures of prevention of diseases should be practiced

Epidemic tremors Epidemic tremors is caused by a virus It is a disease affecting the nervous system of chickens, resulting in a distinct and rapid tremor of the head, neck, and, in some cases, the tail There is usually also an ataxia, or difficulty in walking The first symptoms, usually occurring in 2½ to 4 weeks, are constant trembling and difficulty in walking The condition becomes more pronounced when the chicks are handled The difficulty in walking, in many cases, develops before any signs of trembling, hence, the owner may think that the chicks are affected with rickets The chicks that have an ataxia are handicapped in moving around In later stages, this causes paralysis of the legs, and the bird can move only by kicking its legs and flapping its wings This stage of the disease might appear similar to fowl paralysis

The exact method of transmission is still unknown The diagnosis of this disease must be made upon the characteristic clinical symptoms and the microscopic lesions found in the brain or spinal cord

There is no treatment known that is of any real value in the control or prevention of epidemic tremors

A bird in the advanced stage of fowl paralysis

Avian leucosis Avian leucosis, also known as fowl paralysis, range paralysis, lymphomatosis and neurolymphomatosis, is caused by a virus It manifests itself in different forms, and it may be due to the same, or different viruses

Symptoms Symptoms may appear after the birds are six to eight weeks of age The first symptoms are usually inco ordi nation of the muscles of one or both legs The legs become partially or completely paralyzed Occasionally, the wings and neck also become paralyzed The large nerves leading to the affected legs or wings may be enlarged and yellowish gray in stead of the normal whitish gray color This is the paralysis form of the disease

The visceral form is sometimes called the ' big liver disease The liver and spleen are usually several times the natural size The liver is mottled and sometimes has tumor like nodules

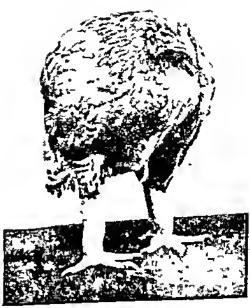
The blindness form sometimes called iritis, first begins with a bleaching of the eye ring The outline of the pupil becomes ragged The size of the pupil is gradually decreased and may finally become completely obliterated This condition is also referred to as gray eyes in birds

The leukemic form of the disease affects chiefly the blood, an examination of which generally reveals the presence of an un usually large number of white blood cells These white blood cells also infiltrate the nerves and other body tissues

Another form of the disease is osteopetrosis, or marble bone.

Control: There is no treatment for affected birds. They rarely recover and should be removed from the flock. Constant culling should be practiced.

Since it is believed that chickens become infected when quite young, early contact of young birds with older birds should be avoided. Young stock should be raised separately from old stock and as far away from them as possible with as little connection as is possible between the two flocks.



Bird affected with osteopetrosis, or marble bone, a form of the avian leucosis complex.

Resistance to the disease may be increased by breeding. This offers one of the best methods of control of the disease.

In many flocks where this disease is causing trouble, coccidiosis and tapeworms are also present. These parasites weaken the birds' natural resistance and when controlled will help towards combating leucosis as well as other diseases.

Blue comb. Blue comb, also known as pullets' disease, X disease, unknown disease, or contagious indigestion, is probably caused by a virus. When this disease was first found, it was thought that eating of new wheat was its cause. This has been pretty well disproved.

This disease is not found in pullets only but may strike yearlings or old birds as well. Most of the outbreaks are found in newly housed pullets, however, about the time when production begins to get heavy and during hot weather.

Symptoms: The birds look droopy and practically stop eating. Their combs turn purple or blue. Production drops quickly. A very characteristic symptom is the change in the appearance of the flesh on the breast, which turns pale. Shriveling of the legs is common. A profuse diarrhea with a highly offensive odor and foamy droppings is also common. The crop

is frequently dilated Hemorrhages in the liver and inflammation and enlargement of the kidneys may be found

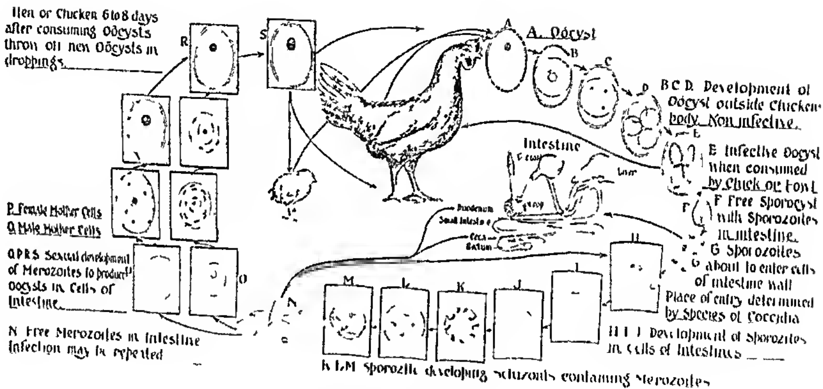
Treatment Prompt action will avoid much of the loss which would otherwise occur Two treatments which have been found successful are the feeding of muriate of potash and molasses In the first treatment, put ½ per cent of muriate of potash (about a tablespoonful) in each gallon of water Do this for four days, then stop using it in the drinking water Begin putting the same drug, muriate of potash, in the feed at the rate of 1½ pounds to each 100 pounds of feed Keep this up for ten days The molasses treatment can be used in various ways One recommendation is to thoroughly mix a pint of molasses per gallon of drinking water for one day Follow this by feeding the following mash mixture for four days three or four times daily 40 pounds of bran, 40 pounds of ground oats, and 20 pounds of molasses, mixed with enough water to make a crumbly mash

Protozoan diseases Protozoa are small, one-celled organisms, the smallest and simplest in the animal kingdom Only a few are the cause of diseases in poultry Some of these are very important economically, however The outstanding examples of protozoan diseases are coccidiosis and blackhead

Coccidiosis Coccidiosis is caused by coccidia, minute parasites that live in the cells that line the intestinal tract The organisms destroy these cells and cause inflammation of the intestines

There are at least eight different kinds, or species, of coccidial organisms The oocysts from these organisms which are microscopic in size, are passed to the outside in the droppings of the birds If the weather is warm and if sufficient moisture and air are present, four cigar shaped spores are formed in each oocyst This takes from one to two days The sporulated oocysts, when eaten by the birds, can produce infection in the intestinal lining The organisms are picked up from the ground or from the feed, the litter, or the drinking water

Inside the intestinal cells, tremendous multiplication of the organisms takes place This increase in numbers is accompanied by sudden severe damage to the intestines, such as bleeding, stripping off of the intestinal lining, or thickening of the intestines If the bird survives this stage, she in turn discharges



Life cycle of coccidiosis organism.

A chick affected with cecal coccidiosis.

usually within a week, millions of oöcysts in her droppings, therefore serving as a source of infection for other chickens; and thus the cycle goes on.

There are two general types of coccidial infections: the cecal, or bloody, type, and the intestinal, or chronic, type.

Cecal coccidiosis. Cecal, bloody, or acute coccidiosis is caused by *Eimeria tenella* and usually occurs in young chicks up to three months of age. The coccidia which cause the cecal type work entirely in the blind gut or ceca near the lower end of the intestinal tract. If one opens a dead bird, he will find the ceca filled with blood. This internal hemorrhage is the immediate cause of death. The blood passes out of the ceca and is evidenced in the bright red, bloody droppings.

The affected birds are depressed and become quite pale and weak. The feathering is usually rough. Mortality may be high.

Intestinal coccidiosis. Intestinal, duodenal, or chronic coccidiosis caused by *Eimeria necatrix* usually attacks birds older than three months of age. The intestinal forms of coccidia do their work mostly in the upper end of the small intestine. There are no marked bloody discharges, but there is a diarrhea with blood stained mucous. The bird becomes progressively weaker and thinner, and finally dies. The outside of the intestines will be peppered with round, white, pinhead sized spots. Mixed among these are small, reddish spots due to tiny hemorrhages. The intestine itself is distended like a sausage and tremendously thickened.

Other types of coccidiosis. A severe diarrhea that may be blood tinged is produced by *Eimeria maxima,* which does its damage to the small intestines. *Eimeria brunetti* causes a sloughing off and alteration of the intestinal lining of both young and old birds. *Eimeria acervulina* infests the intestines

of older birds and produces white streaks across the lining of the upper part of the gut. *Eimeria mitis* is known to cause a diarrhea. *Eimeria praecox* and *Eimeria hagani* do little recognizable damage.

Control: In controlling the disease, it must be understood that the coccidia are usually present but that the trouble is caused by massive concentrations of the organisms. Keeping the surroundings dry prevents the rapid multiplication of the organisms. Cleaning out the droppings and litter also will remove most of the organisms. The more crowded the chickens are, the quicker the coccidia multiply and the better the chances of the birds consuming large numbers of the organisms.

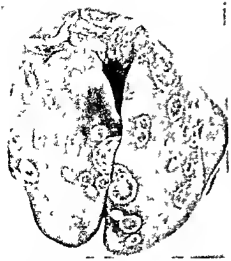
Normal ceca (left); ceca of chick affected with coccidiosis (right). The affected cecum has been opened showing the dark, bloody contents.

The best preventives of coccidiosis are dryness under foot, sunshine, and freedom from crowding.

Treatment: Medication will aid in the control of coccidiosis. It will not cure infected birds but will only prevent an outbreak from becoming more severe. Medication without sanitation will have little beneficial effect.

Flowers of sulfur, ground sulfur, and sulfa drugs can be used as an aid in controlling coccidiosis. It is essential, however, that an accurate diagnosis of the infection be made before medicating the birds.

Five pounds of sulfur in 95 pounds of feed will prevent infection but will not cure birds infected with bloody cecal coccidiosis (*Eimeria tenella*) or with *Eimeria necatrix*. Do not feed sulfur for more than two weeks. Increase the vitamin-D content four times normal to prevent rickets if the birds are indoors. No extra precautions need be taken if the birds are



Liver with lesions caused by blackhead.

outdoors and exposed to sunlight. Clean up the house or move the birds to another range, and then stop the sulfur feeding. None of the other types of coccidiosis are helped by sulfur.

The sulfa drugs which have given the best practical results are sulfaguanidine, sulfamethazine, sulfamerazine, and sulfaquinoxaline. These drugs are usually given by the so called intermittent treatments. This means giving the birds the drugs either in feed or water for one or more days as soon as the trouble is discovered, then skipping a certain number of days during which the regular mash and clear water are provided. This is followed by a second treatment and then a third treatment if necessary. Sulfaquinoxaline fed continuously in the feed at a low concentration is also effective in the control of cecal and intestinal coccidiosis.

Blackhead. Blackhead is caused by microscopic protozoan organisms called *Histomonas meleagridis.* It is primarily a disease of turkeys, but other fowls are sometimes affected. The disease affects the liver, and the most noticeable symptom is an enlarged liver covered with sunken, ulcerated areas. The ceca are also involved, becoming enlarged, inflamed, and filled with a cheesy, corelike mass. Blood is frequently found in the core.

Control: No satisfactory medical treatment has been found for this disease. The best method of prevention and control is the employment of strict measures of sanitation and hygiene in which young turkeys are kept away from older birds and both are kept entirely away from chickens. Phenothiazine has proved effective by controlling the cecal worm which is the intermediate host of the blackhead organism. Enheptin has been reported of promising value in reducing the disease.

Fungus diseases. Molds or fungi are low forms of plants. A

few are capable of producing disease in poultry Examples of such are favus, aspergillosis, and thrush

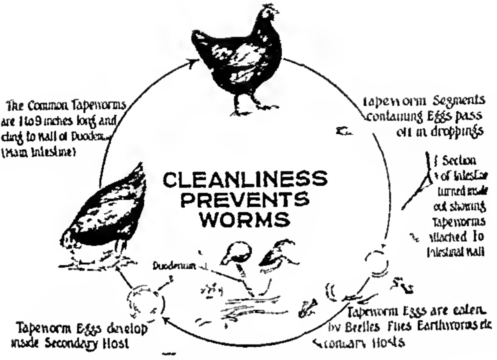
Internal parasites. Poultry are susceptible to infestation by a large number of internal parasites Very few flocks are entirely free from them The damage done is both direct and indirect The symptoms of worm infestation vary, but are usually not definite enough for accurate diagnosis Worm infestation is usually accompanied by stunted growth, emaciation, weakness, or death, and by lowered production

There are two principle types of internal parasites of poultry, namely the tapeworms and the roundworms

Tapeworms Tapeworms may be very tiny or up to as much as 5 inches in length The smaller types are commonly called microscopic or semimicroscopic, although they might be seen when washed free from the intestinal contents Tapeworms attach their heads to the tissues of the intestinal lining For this reason they are hard to dislodge The worms consist of a number of segments, and those farthest from the head are continually breaking off and passing out with the droppings These segments are filled with eggs Tapeworm eggs cannot produce new worms when they are eaten by another animal All tapeworms must have two hosts in order to complete their life cycle The intermediate hosts of the chicken tapeworms are not always known, but it is known that certain flies, slugs, snails, and beetles serve for some of them and no doubt others exist. The tapeworm eggs in the droppings, when eaten by the appropriate intermediate host, hatch into dormant forms which eventually will die unless the slug, beetle, or whatever the intermediate host may be is eaten by a chicken In this case, the dormant form escapes when the intermediate host is digested and immediately develops into a tapeworm

Control Treatment has not been entirely successful because the head of the tapeworm is usually buried in the wall of the intestines where it is practically impossible for any drug to reach it Some flocks may be helped by tapeworm remedies, but complete control is not possible

The best solution of the tapeworm problem is prevention This begins with rigid culling of the flock, followed by sanitation and healthy management practices Control or elimination of intermediate hosts is also helpful

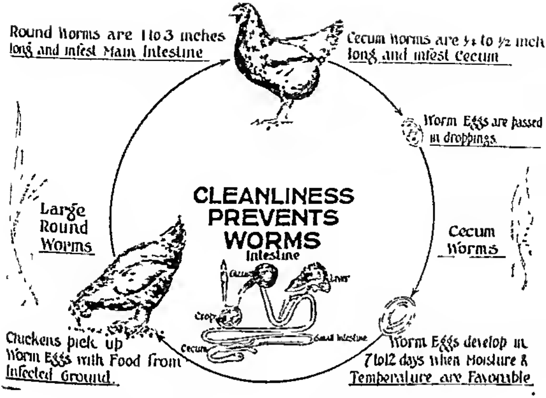


Life cycle of poultry topeworm

Roundworms Roundworms (nematodes) are elongated, cylindrical, unsegmented worms varying greatly in size and in location in the body of the fowl They are usually grayish white in color

The large roundworm, *Ascendia lineata,* is the most common It varies from 1 to 3 inches in length and is easily seen in the intestines where it is found unattached The female worm deposits eggs which are passed out with the droppings These eggs microscopic in size, remain in the soil or pens until proper moisture and temperature conditions favor their development. The eggs are so numerous that the food and drink of the birds become easily contaminated When the developed egg is swallowed and reaches the intestinal tract, the egg capsule is lost, and an immature worm, which eventually grows into an adult, is released An intermediate host is not necessary for the spread of this parasite between birds.

Control Nicotine is the most effective drug It can be fed in the form of 2 per cent tobacco dust in the mash or each bird may be given a pellet containing the nicotine If fed in



Life cycle of large roundworm and of cecum worm of poultry.

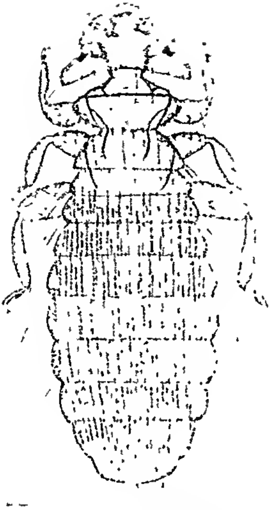
the mash, it should be fed for about a week; the birds are then flushed with epsom salts. This will kill the worms but not the worm eggs. Therefore, the house should be cleaned and after three weeks the treatment repeated. The practice of sanitary measures will help in the control of the worms.

Other roundworms. Other forms of roundworms are present in chickens but are not as common as the large roundworm. They are cecal worms, capillaria worms, gizzard worms, stomach worms, eye worms, and gapeworms.

External parasites. Many kinds and varieties of external parasites are known to infest poultry. These include lice, mites, ticks, fleas, and bedbugs.

While the losses by lice and mites are not always apparent, the discomfort and the loss of blood they cause lower the production of a flock and probably predispose the fowls to poultry diseases. The control of lice and mites is a practical way to help increase the needed high production.

Lice. Seven kinds of lice are common on chickens, but usu-



The shaft, or common, louse.

ally only three of these—the head louse, the body louse, and the shaft louse—are of major importance. These names are applied to the varieties according to where they are found. These parasites are readily seen with the naked eye. They may be found moving rapidly about by examining the skin over the breast and under the wings. Eggs are deposited in clusters at the base of the feathers, usually around the vent. They hatch in a few days under normal conditions. The young are almost white when first hatched but darken in color later. The adult stage is reached in about 17 to 20 days after hatching. Lice live permanently on the chickens except when they migrate from

one bird to another Usually they do not live longer than one or two days off the birds It is therefore unnecessary to consider the litter, the nest material or the house Lice are accidental in these places All birds in a flock are likely to be lousy if one or two are infested

Control Nicotine sulfate is the most convenient material for the control of lice in large flocks because it can be applied quickly and does not require handling individual fowls The nicotine sulfate is applied to the top surface of the roosts a half hour before the flock goes to roost Heat from the bodies of the birds vaporizes the material which rises through the feathers Nicotine sulfate is applied undiluted with an oilcan, a brush, or the applicator top which comes with some sizes of containers Only a narrow line of material is needed on each roost The convenience of nicotine sulfate outweighs the two minor objections to its use namely, that all head lice may not be killed because they are usually on the head and neck and are somewhat removed from the source of the fumes, and some birds may not occupy the roosts the nights the treatment is made Periodic treatments determined by inspection of the birds, will keep lice under practical control, however

Sodium fluoride is a good louse killer for small flocks or if the handling of individual birds is not objectionable It is a poisonous powder and should be used carefully Poultry can be treated with sodium fluoride by dusting or by the so-called pinch method In the dusting method the powder can be diluted with two parts of flour or sulfur The dust is applied with a shaker while a helper holds the bird The feathers should be raised so that the dust will reach the skin It should be put on lightly, for heavy deposits are unnecessary and might be injurious The birds should be dusted over a pan or tray so that the wasted dust can be recovered Dusting should be done out of doors or in a large room away from the pen in which the birds are kept If dusting is done indoors, the operator should wear a respirator or a piece of damp cloth over the mouth and nostrils

The pinch method has the advantage of using less material, requiring the work of only one person, and producing less dust to be inhaled The bird is held in one hand with its wings over its back and small pinches of sodium fluoride are applied

Courtesy Future Farmers of America

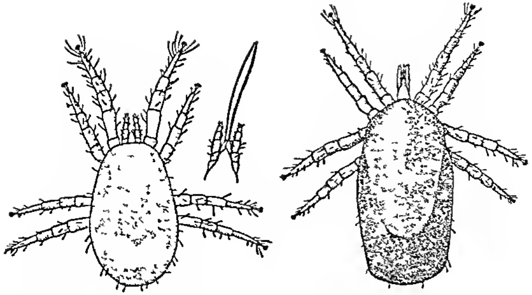
Hand dusting, as demonstrated by this FFA member, is a practical method of parasite control for owners of small poultry flocks.

among the feathers next to the skin as follows: two along the back, one on the neck, one on the head, one on the breast, one below the vent, one on each side, one on the tail, and one on the underside of each spread wing.

Blue ointment is effective for the control of chicken lice, but it also requires handling of individual birds. The ointment as purchased is mixed with two parts of Vaseline, and a pea sized lump is applied on the areas under the vent and under the wings. The material must be placed on the skin. It remains effective long enough to kill lice that hatch several days after treatment.

Mites. Many kinds of mites infest foultry, but only four of these are common. They are the common chicken mite, the feather mite (or northern fowl mite), the depluming mite, and the scaly-leg mite. Of these four, the common red chicken mite is the one that most frequently injures flocks.

The common red chicken mite is a blood-sucking pest that lives and reproduces in cracks and other protected places in roosts, nest boxes, walls, and ceilings, coming out only at night to attack its host. Few of them will be found on birds in the daytime. The adult mites are about the size of a pinhead and are bright red after they have fed. This mite is controlled by treating its daytime hiding places. The roosts, roost supports, nest boxes, and adjacent parts of walls, window sills, casings, and floors are then painted with carbolineum, crude petroleum, or creosote oil. Care must be exercised in handling these materials since they are somewhat caustic. The birds



The common chicken mite. At left, before feeding; at right, when fully engorged.

should not be returned to the treated houses until at least a few days after treatment.

The feather mite, or northern fowl mite, resembles the common chicken mite, but it is slightly smaller and more active. It can be distinguished by its habit of living continually on the fowls and by dirty plumage of the bird it attacks. In heavy infestations it may be seen running over eggs in the nests. Because it stays on the birds, both fowls and house must be treated. The mites on the fowls can be killed by dusting them thoroughly with fine sulfur. The house can be treated the same as for the common chicken mites.

The depluming mite lives in the follicles of the bases of feathers and sets up a severe irritation that incites the birds to pick at the plumage, thus causing many feathers to fall off or to break. The mite is barely visible to the naked eye, but its presence can be determined by the crusts of exudates which form about the bases of feathers on infested birds. Thorough dipping in a sulfur bath is the only dependable way to control the depluming mite. The dip is prepared by adding two ounces of fine sulfur and ½ ounce of laundry soap to each gallon of tepid water. The fowl should be immersed with its wings over its back, and the feathers ruffled so that the dip will

Scaly leg. The drawing at the left shows an infested leg, and that on the right, a normal leg.

reach the entire surface of the skin. The head should be ducked two or three times.

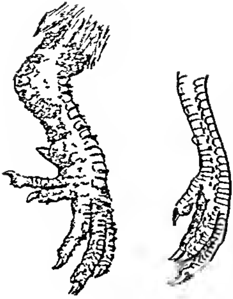
The scaly-leg mite is related to the depluming mite. He lives under the scales of the legs and feet and causes an unsightly condition and sometimes permanent deformity or loss of the tips of the toes. For the control of these mites, the legs of infected birds should be dipped in crude petroleum, taking care not to immerse them above the hocks or to get oil on the feathers. If many scales remain after a month, a second dipping is needed.

Nutritional diseases. The fact must be kept in mind that certain abnormal conditions are the result not of specific organisms but of a lack of some constituent of the diet. Since the results of these deficiencies produce conditions in the birds which appear similar to the conditions caused by true diseases, they are referred to as nutritional deficiency diseases. The more common of these conditions are described in the chapter dealing with feed nutrients (Chapter 6).

MISCELLANEOUS CONDITIONS CAUSING LOSSES

Most of the losses can be attributed to disease. There are other losses attributable to conditions which are not disease, however, but in the case of some of the losses they are frequently looked upon as disease.

Bumblefoot. Bumblefoot is an abscess formation in the region of the foot pad or between the toes. Poor roosting facilities and unsuitable floors and yards cause the condition. Suitable roosts without sharp edges, plenty of litter, and runs not too hard on the birds' feet should be provided. Individual treatments consist of opening the abscess on its upper side



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Poisonous substances. Cases of poisoning are not very common, but the fowls frequently have access to poisonous substances. Most of the drugs and chemicals which are likely to cause harm belong to the so-called "mineral poisons." Ordinarily fowls have access to them only as a result of accident or carelessness. Some of these are arsenic from poisons and spray materials, copper sulfate, lead from paint, mercuric ointment, and nicotine sulfate. An excessive amount of salt is toxic, but the amount to produce harmful results is very much higher than is ordinarily recommended.

DIAGNOSIS OF DISEASE

As previously indicated, it is important to get an accurate diagnosis of a disease in order to inaugurate proper control measures. The diagnosis should be made by a competent person, but the layman can be familiar with some of the diagnostic symptoms.

External symptoms. Characteristic appearance or functioning of parts of the body as one looks at the bird will help to diagnose a condition. The more common external symptoms of diseases are indicated in Table 72.

Internal symptoms. Some of the organs of the body are also affected by disease. These frequently produce characteristic appearances. The more common of the internal symptoms, as revealed by autopsy examination, are given in Table 73.

Both external and internal symptoms of disease should be used as guides toward the final diagnosis. Where a specific organism is involved, its isolation is the final answer in determining the disease.

CONTROLLING DISEASE

In the control of disease treatment, when possible, is necessary. However, prevention is also necessary.

Treatment of disease. The small value of the bird usually makes individual treatment impractical. For certain diseases and conditions, however, flock or mass treatment is possible. Some of the medications or materials useful for controlling poultry diseases are indicated in Table 74. The table indicates the materials recommended and the conditions for which they should be used. For details of application, consult the discus

TABLE 72. DIAGNOSIS OF DISEASES BY EXTERNAL SYMPTOMS

TROUBLE FOUND HERE	CONDITION	DISEASE INDICATED
Comb	Purple or deep red	Cholera, poisoning, blue comb
	Pale	Parasites, typhoid, tuberculosis
	Blister or scabs	Fowl pox
Wattles	Swollen	Infectious coryza, cholera
	Blisters or scabs	Fowl pox
Eyes	"Gray-eyes," blindness	Leucosis
Eyes and nostrils	Discharge	Colds, roup, coryza, laryngotracheitis, vitamin-A deficiency
Head	Tremors	Newcastle disease, epidemic tremors
Crop	Distended	Crop bound
Wings	Droopy	Parasites, coccidiosis, vitamin-A deficiency
Legs	Paralysis or difficulty in walking	Injury, bumblefoot, rickets, perosis, leucosis, tapeworms, coccidiosis, Newcastle disease, epidemic tremors
	Curled toes	Riboflavin deficiency
Feathers	Unthrifty	Worms, lice, mites, folic-acid deficiency
	Falling out or missing	Feather pulling, feather mite
Diarrhea	Green	Typhoid
	White	Pullorum
	Foamy	Blue comb
	Bloody	Coccidiosis, cholera
Respiration	Difficult (gasping, sneezing or coughing)	Infectious bronchitis, gapes, infectious laryngotracheitis, Newcastle disease, cholera
Weight	Light, emaciated	Parasites, chronic coccidiosis, leucosis, tuberculosis

sion dealing with the particular disease, parasite, or practice involved.

Vaccinations. In the control of some poultry diseases, vaccination is suggested as a treatment. Such diseases are as follows: fowl pox, fowl typhoid, infectious laryngotracheitis, Newcastle disease.

Blood testing. In the case of pullorum disease, blood testing to remove reactors is the suggested method of control.

TABLE 73 DIAGNOSIS OF DISEASES BY INTERNAL SYMPTOMS

Organ	Condition	Disease Indicated
Ceca	Bloody	Acute coccidiosis
	Cheesy core	Blackhead
Heart	Small hemorrhages	Cholera
	Grayish spots	Typhoid
Intestines	Congestion	Cholera, parasites, coccidiosis, poisons, typhoid
	Thickened, ulcers	Parasites, coccidiosis, tuberculosis, blackhead
	Nodules	Tapeworms, tuberculosis
Liver	Enlarged	Typhoid, leucosis, blackhead
	Spots, nodules, or ulcers	Typhoid, coccidiosis, tuberculosis, blackhead, pullorum
	Hemorrhages	Blue comb
Lungs and air sacs	Congested with blood	Cholera
	Abscesses or pus spots	Pullorum
Ovary	Yolks discolored or irregular	Pullorum
Windpipe	Bloody contents or yellow mucus	Laryngotracheitis

TABLE 74 MATERIALS COMMONLY RECOMMENDED FOR THE PREVENTION AND CONTROL OF POULTRY DISEASES AND PARASITES

Material	Use
Carbolineum	Mites, disinfectant
Creosote	Disinfectant, parasiticide
DDT	Flies, northern fowl mite
Epsom salts	Laxative
Formalin and potassium permanganate	Incubator fumigation
Kerosene	Scaly leg mite
Lye	Cleaning
Lysol	Disinfectant, parasiticide
Mercurial ointment	Lice
Molasses	Blue comb
Muriate of potash	Blue comb
Nicotine sulfate (Blackleaf 40)	Roundworms, lice
Phenol	Antiseptic, parasiticide
Sodium fluoride	Lice
Sulfa drugs Phenothiazine	Cecal worms
Sulfathiazole	Coryza
Sulfaguanidine, Sulfamethazine, Sulfamerazine, Sulfaquinoxaline	Coccidiosis, cholera
Sulfur	Acute coccidiosis, northern fowl mite, feather mite
Tobacco dust	Roundworms

GLOSSARY

General Terms

agglutination: a clumping, applied to the clumping of the germs in the blood test for pullorum disease
antigen: a water suspension of germs
antitoxin: a serum that has the toxin-neutralizing properties
autopsy: a post-mortem examination; examination of the organs of the dead animal

bacterin: a suspension of dead germs used for immunizing. It is frequently referred to as a vaccine, but in a true vaccine the bacteria are living whereas in a bacterin they have been killed.

carrier: a bird harboring disease-producing agents

diagnosis: the determination of the nature of a disease
disinfectant: an agent that destroys infective agents
dormant: the same as a resting stage

host: a term applied to a bird harboring parasites

immunity: the ability of the individual to withstand disease
infection: an invasion of the tissues by pathogenic organisms
infestation: the entrance and disease production in birds by worms

lesion: any pathological change in tissue

microscopic: pertaining to bodies which can be seen only with the help of a microscope

oöcyst: a resistant form of the coccidium

pathogenic: the ability of a causative agent to produce disease
pathologist: one who is skilled in interpreting the bodily changes due to disease

reactor: a term used to designate positive results of various tests
resistance: the ability of the individual to withstand disease

semimicroscopic: pertaining to bodies not readily seen without the help of a microscope but visible to the unaided eye
spore: a seedlike body formed by some germs. These spores are usually very resistant to drying and chemical disinfectants.

take a word used to indicate skin or cloacal reaction in pox and bronchitis vaccination

toxin a poison secreted by germs

tuberculin a substance prepared from tuberculosis germs When this product is inoculated to detect tuberculosis, it is referred to as the tuberculin test

ulcer decaying tissue which has an open cavity

vaccinate to inoculate for the purpose of increasing resistance against disease

vaccine a suspension of living disease producing agents

virulence the relative infectiousness of a microorganism

Anatomical Terms

air sac a space in the body of the bird which communicates with the lungs and the large bones

ceca (see ka) the paired blind pouches communicating with the intestine

cloaca the pouch of which the vent is the outside opening

kidneys the two large lobulated bodies on either side of the spine

liver a glandular organ, normally dark brown in color, consisting of two main lobes, to which the greenish gall sac is attached

nasal a term pertaining to the nose

nasal chambers cavities in the upper part of the beak

ovary the organ which produces egg yolks

spleen a reddish brown round body lying between the liver and the gizzard

SUGGESTIONS AND QUESTIONS

1 Make a survey of poultry losses in your area

2 To what extent are vaccination and blood testing practiced in your locality?

3 What sanitary measures are commonly employed on the farms in your neighborhood?

4 Visit a diagonostic laboratory and observe if possible a post mortem examination of a chicken

5 List the diseases which have been reported in your locality during the past year

6 Have there been any epidemics? What diseases?

7 What measures are being employed on your farm to prevent the occurrence of disease?

8 How are dead birds disposed of on your farm? Is this the common practice in your neighborhood?

9 To what extent is disinfection practiced on the farms in your area? What disinfectants are generally used?

10 Make a list of the poultry remedies offered for sale in your market

11 Have there been any reports of nutritional deficiency diseases in your area? If so, which ones?

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SCHWARDT, H H, and BRUCKNER J H *Control of Poultry Lice and Mites* Cornell University Extension Bulletin 595, 1943

domesticated by the Indians in America at the time of its discovery. They were taken back by the early explorers, and from Spain the turkey spread throughout Europe. From them, new varieties originated. Some of these varieties were brought back to this country by the early colonists.

There are two kinds of wild turkeys: the occelated turkey, native to the Yucatan peninsula of Mexico and adjoining territory, and the North American wild turkey. The occelated turkey has had little or no influence on the development of the domestic turkey. The domestic varieties are descendants from the North American wild turkey. In this family there were five distinct varieties varying somewhat in color and pattern and having different original habitats. The five varieties are as follows: (1) the Mexican turkey (Central Mexico), (2) Merriam's turkey (Mountains of Southern Colorado, New Mexico, Arizona, Western Texas, and part of Northern Mexico), (3) the Rio Grande turkey (middle Texas and parts of Mexico), (4) the Florida turkey (Florida), and (5) the Eastern turkey (southeastern United States to Oklahoma and east and northeast to New England).

The present day varieties of turkeys have been developed by breeding the European strain and the native wild bird.

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Turkeys of all varieties have certain common characteristics. The female turkey is similar in all sections to the male though smaller and finer in bone structure.

The head. The head of the turkey is particularly characteristic, primarily because of its furnishings. It should be moderately long, deep, broad, carunculated with a tubular leader at the base of the beak (sometimes called the snood), the size of which is subject to extension or contraction. The head is usually red, changeable to bluish white. The beak should be of medium length, strong, curved, and well set in the head. The eyes should be full, oval, and prominent, possessing a bold expression. The eyes are usually brown or dark brown in color.

The neck. The neck should be moderately long, erect, gracefully curved, blending into the back. The throat section is heavily carunculated. The beard, which is usually black, is

8. How are dead birds disposed of on your farm? Is this the common practice in your neighborhood?

9. To what extent is disinfection practiced on the farms in your area? What disinfectants are generally used?

10. Make a list of the poultry remedies offered for sale in your market.

11. Have there been any reports of nutritional-deficiency diseases in your area? If so, which ones?

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take a word used to indicate skin or cloacal reaction in pox and bronchitis vaccination
toxin a poison secreted by germs
tuberculin a substance prepared from tuberculosis germs When this product is inoculated to detect tuberculosis it is referred to as the tuberculin test

ulcer decaying tissue which has an open cavity

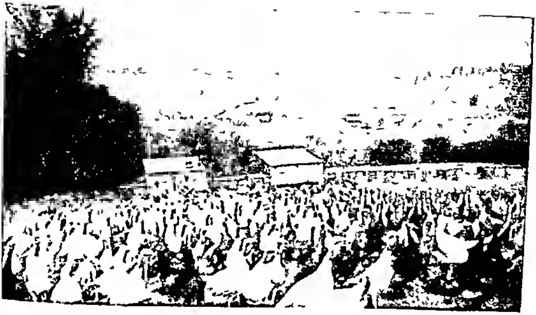
vaccinate to inoculate for the purpose of increasing resistance against disease
vaccine a suspension of living disease producing agents
virulence the relative infectiousness of a microorganism

Anatomical Terms

air sac a space in the body of the bird which communicates with the lungs and the large bones
ceca (see ka) the paired blind pouches communicating with the intestine
cloaca the pouch of which the vent is the outside opening
kidneys the two large lobulated bodies on either side of the spine
liver a glandular organ normally dark brown in color consisting of two main lobes to which the greenish gall sac is attached
nasal a term pertaining to the nose
nasal chambers cavities in the upper part of the beak
ovary the organ which produces egg yolks
spleen a reddish brown round body lying between the liver and the gizzard

SUGGESTIONS AND QUESTIONS

1 Make a survey of poultry losses in your area
2 To what extent are vaccination and blood testing practiced in your locality?
3 What sanitary measures are commonly employed on the farms in your neighborhood?
4 Visit a diagonostic laboratory and observe if possible a post mortem examination of a chicken
5 List the diseases which have been reported in your locality during the past year
6 Have there been any epidemics? What diseases?
7 What measures are being employed on your farm to prevent the occurrence of disease?



White Holland turkeys on range.

ease. Although it is safer not to have chickens on the same farm with turkeys, they both can be raised provided their housing units are separated. The adaptation of artificial and large-scale methods of incubation, brooding, housing, feeding, and other management practices has also stimulated production. Because of a better understanding of these factors as well as an increased demand for turkey, production has been on the increase in all sections of the country. The number of farms producing turkeys has decreased, however, indicating that turkey raising has become a more specialized industry.

In the early days the turkey was a rarity and was therefore served only on special holidays and for particular feasts. In the United States the turkey formed the centerpiece of the feast prepared by the Pilgrim Fathers in solemn thanksgiving for the completion of their first year in the new land and has become thoroughly established as the Thanksgiving Day tradition. Later the turkey also became a Christmas Day dish, and now with increased production is being served the year-round.

ORIGIN OF THE TURKEY

The turkey is distinctly a gift of the Americas to the world. More than 400 years ago Cortez and his followers found this strange, new bird in Mexico. Turkeys existed both wild and

CHAPTER 15

Growing Turkeys

POULTRYMEN and farmers in all sections of the United States have always been interested in turkey production. At first New England was one of the principal areas of turkey production, but there has been a gradual movement westward. In the early days turkeys were raised with chickens, ducks, and guinea fowls mostly as a sideline on farms. The turkey hens laid the eggs and then hatched and raised the poults. During the first few weeks they ran around the barnyard or homestead or were confined with other kinds of poultry. Later the turkeys were allowed to roam at will over the farm.

When turkey production became unprofitable in the east because of diseases, the industry moved to cleaner and wider ranges in the Midwest and the West. In each area turkey production had a good start but was usually abandoned when disease entered the picture. The growers always felt that free range was essential for the raising of turkeys. Frequently, turkey raising was abandoned for a period of years with the idea that the disease could be eliminated. When turkeys were again raised, however, blackhead once more took its toll. This was due to the fact that usually turkeys and chickens were allowed to run together, and it has been shown that the chickens can carry over the blackhead organism from year to year without the disease seriously affecting the chicken flock.

There has been a steadily increasing number of turkeys raised for the past ten years. This increase can be attributed in part to the increase in scientific information concerning the growing of turkeys. One of the factors is the realization that turkeys must be segregated from chickens because of the danger of dis-

long, bristly, and prominent in adult males. It is not required in females.

The body. The breast should be broad, deep, full, and well rounded, being carried well forward and slightly above the horizontal. The keel should be medium in length, slightly convex, and full fleshed throughout its entire length. The back should be broad, sloping from the neck in a convex curve to the tail. In general, the body should be broad, deep, and compact. The wings should be large, powerful, smoothly folded, and carried well up on the side. The feathers should be broad and overlapping. The tail should be rather long, with broad feathers, and it should be carried low in a continued graceful curve in line with the back.

A Narragansett tom.

The legs and toes. The legs should be of medium length, strong, straight, set wide apart, and well filled out with flesh down to the hock. The shanks should be strong, of good substance, and moderate in length. The toes should be straight, strong, and well spread.

VARIETIES OF TURKEYS

The *American Standard of Perfection* recognizes the following varieties of turkeys: Bronze, Narragansett, White Holland, Black, Slate, and Bourbon Red.

For detailed descriptions of both male and female of the standard varieties, as well as for disqualifications, the *American Standard of Perfection* should be consulted.

The standard weights for the various varieties of turkeys are presented in Table 75, and color characteristics are presented in Table 76.

The nonstandard varieties of interest are Broad-Breasted Bronze, Beltsville White, Jersey Buff, Nittany, and Royal Palm.

domesticated by the Indians in America at the time of its discovery. They were taken back by the early explorers, and from Spain the turkey spread throughout Europe. From them, new varieties originated. Some of these varieties were brought back to this country by the early colonists.

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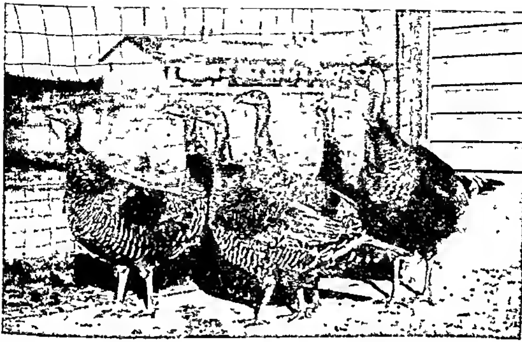


Broad-Breasted Bronze. This is one of the more recently developed varieties that has made for itself an important and permanent place on the farms of the country.

than varietal differences. The differences between the strains within a variety are more likely to be greater than differences between the varieties themselves.

One should choose the best strain of the variety that suits his purpose. Besides color, some of the factors involved in making the choice are these: the proper size for the market, a rapidly growing strain, good fleshing particularly of the breast and thighs, and efficient producers.

Each of the varieties has certain advantages and disadvantages. The Broad-Breasted Bronze and White Holland make up most of the turkeys grown at the present time.

Broad-Breasted Bronze. The Broad-Breasted Bronze is the heaviest of all varieties. It may tend to be too large for family use, but it is excellent for hotel, restaurant, steamship, and railroad diner trade. When fully finished, it has excellent skin color and presents a beautiful meat carcass. However, as is true for all dark-feathered varieties, a disadvantage is the prominence of dark pinfeathers when dressed before completely finished and blue-black pinfeathers in spots that have been picked. The Broad-Breasted Bronze has become popular because of its

TABLE 75. STANDARD WEIGHT OF TURKEYS (POUNDS)

VARIETY	TOMS			HENS		
	Adult	Yearling	Young	Adult	Yearling	Young
Bronze	36	33	25	20	18	16
Narragansett, White Holland, Black, Slate, Bourbon Red	33	30	23	18	16	14

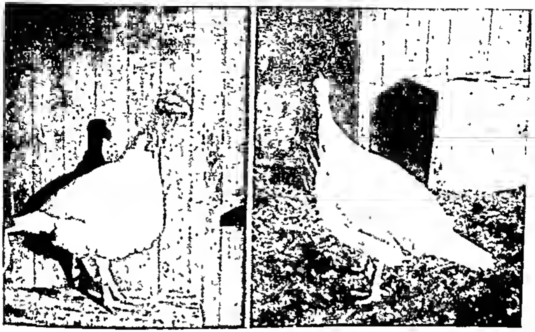
TABLE 76. CHARACTERISTIC COLOR OF STANDARD VARIETIES

VARIETY	PLUMAGE	BEAK	LEGS
Bronze	Copperish bronze with barring, black and white	Horn	Black
Narragansett	Black or steel gray with barring	Horn	Black
White Holland	White	Light pinkish horn	Pinkish white
Black	Black	Slaty black	Slaty black
Slate	Slaty or ashy blue	Horn	Pink
Bourbon Red	*Chestnut mahogany with* white, red, and black	*Light to dark* brown	*Reddish pink* or horn

SELECTING A VARIETY

In selecting a variety one should consider personal preference, sources of good breeding stock, outlets for surplus breeding stock, and market turkeys The farmer and commercial raiser are interested in a turkey that grows rapidly, has little mortality, has good body type, and is well fleshed especially over the breast and thighs

Sales of fancy-colored showbirds at high prices are so seldom made that the income from this source is relatively unimportant The turkey breeder who is interested in producing hatching eggs, poults, and breeding stock is interested in egg production, high fertility and hatchability, livability, and good plumage color. Good color pattern as well as uniformity in color, shape, and type increases pride in producing the bird and adds to the sales appeal of the flock. High egg production, high fertility, and good livability are not exclusive characteristics of any particular variety. Such characters can be developed in any variety and have been developed in some strains of most varieties. Therefore, these are strain differences rather



White Holland: male (left); female (right).

Photographs from U. S. Department of Agriculture

Beltsville Small White: male (left); female (right).

of any variety which are satisfactory may be secured. In the case of some of the colored varieties such as the Bourbon Red, Jersey Buff, and Royal Palm, there is the additional difficulty of maintaining the color pattern. In the case of the small varieties, the cost of production is relatively higher than with the best strains of some of the larger varieties. There might

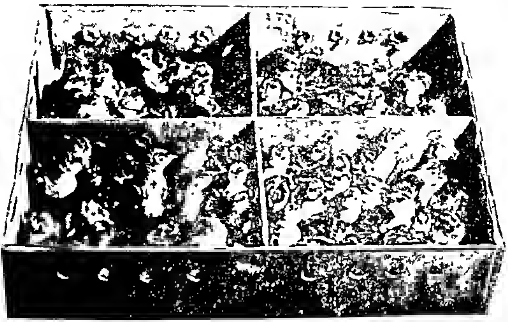
excellent rate of growth and the broad breast, particularly at early ages, which makes them good for broilers They also make economical gains Some strains are characterized by low fertility and hatchability There is also a greater tendency toward pendulous crop and for the birds to go down on their legs when in confinement They mature somewhat later than White Hollands

Standard Bronze. The Standard Bronze or Mammoth Bronze variety is similar in most respects to the Broad Breasted Bronze It is large in size, rugged, and does well in confinement or on range The chief difference is in the conformation or amount of the breast meat

White Holland The White Holland has been developed as an excellent utility bird In general, it shows rapid economical growth and relatively high dressing percentage, and good egg production, fertility, and hatchability Many strains have superior meat type with a broad breast and thick flesh over most of the carcass The hens are of good size for family use, and the toms are excellent for hotels, restaurants, railroads, and steamship line trade As with all white birds they have an advantage over colored ones because the white pinfeathers are inconspicuous and the white feathers have commercial value They mature earlier than the Broad Breasted Bronze and possibly stand confinement better, but there is also the tendency for them to fight in confinement On the other hand, they mature somewhat later than the Beltsville Small White As broilers the carcasses do not show up as well as the Broad Breasted Bronze

Beltsville Small White The Beltsville Small White has been developed by the United States Department of Agriculture because many families prefer a small turkey The hens will weigh about 7 to 10 pounds dressed and the toms, 13 to 16 pounds Except for size, their characteristics are very similar to White Hollands

Other turkey varieties Other varieties of turkeys are not produced in large numbers, usually because they have certain undesirable characteristics as compared with the popular varieties already mentioned Considerable variation exists in the different strains of any variety, and, hence, particular strains



Poults ready for delivery. Poults are shipped by mail and express as are baby chicks, but it is preferable to deliver them directly from producer to buyer in delivery trucks or automobiles.

during the growing period. This system is usually preferred when clean, green pastures are not available, when less than from 500 to 1,000 birds are to be grown, and when turkeys and chickens are grown on the same or nearby premises. It is also best for those persons who have only a limited amount of time to spend in caring for the birds. Even large specialized turkey growers sometimes prefer the complete confinement method of rearing. Many flocks of from 5,000 to 10,000 birds are grown each year by this method. The complete-confinement system is essential for the success of a backyard turkey enterprise.

Semiconfinement. In the semiconfinement system, day-old poults are started in a brooder house or brooder compartment with a sun porch attached. They are never permitted to touch the ground until they are old enough to go onto pasture range. Poults started early in the spring, or in cold climates, may need to be confined until ten weeks of age or older. Those started in warm climates, or after April 15, should usually be able to go on the range at from six to eight weeks of age. This system is usually preferred when clean pastures are available and when enough turkeys are grown to justify the extra work of feeding

also be a difference in selling price because their smaller size brings them in direct competition with ducks, capons, and large fowl.

GETTING A START

Usually the best way to start the turkey enterprise is to buy day-old poults. In this way plans can be made for any desired number to be delivered at specified dates. It is best to buy as near home as possible and to select a source of stock that others have reared with success.

Starting with poults eliminates the expense and uncertainities of feeding and carrying over the breeders and troubles of incubation.

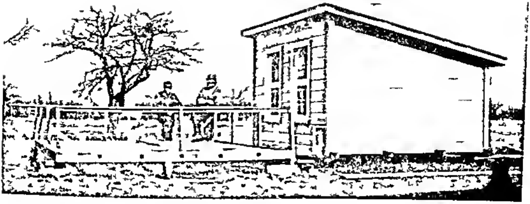
In some cases started poults have been used. These are poults that have been grown ten days to several weeks of age. There is no advantage in getting started poults, and there might be certain disadvantages.

BROODING AND REARING THE POULTS

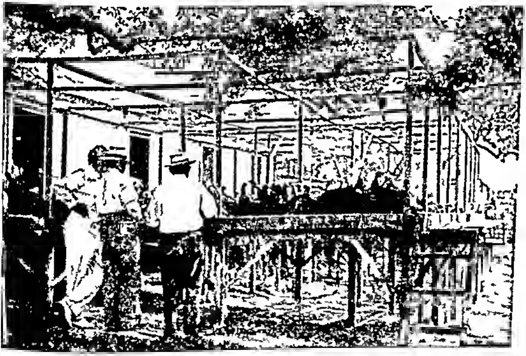
Brooding poults with hens. If a small number of poults are raised (say 50 or less), you can use either chicken or turkey hens. Confine the poults to the coop with the hen for the first two or three days. The hen should be confined in the coop for at least two weeks. At the start the poults should also be confined within an enclosure attached to the coop, but the coop should be moved every few days to prevent soil contamination. The poults must be watched carefully, especially in rainy weather. After the poults are fairly well grown, the hens may be allowed outside the coop to forage with the poults.

Brooding poults artificially. If 100 or more poults are raised, artificial brooding is preferable over natural brooding. There are several systems of brooding and rearing turkeys. The system adopted should be the one that best fits the particular conditions under which the turkeys are to be grown. The two common systems are discussed here.

Complete confinement. In the complete-confinement system, the birds are kept in the brooder house and sun porch throughout the entire growing period; though they are sometimes moved from the regular brooder quarters to a larger sun porch after the eighth or tenth week and confined to this



A colony house and sun porch for turkeys The house and porch (each 10 by 20 feet) provide adequate quarters for from 125 to 150 poults to ten weeks of age.



A long permanent type of brooder house and porch for turkeys. Head room has been provided both on and under the porch

must be controlled to prevent drafts on the poults, especially during the first few weeks of brooding

Sun porches. When conditions permit, the sun porch should be on the south side or the east side of the brooder quarters, as this provides maximum sunshine for the poults. A portion

and watering them on the range Pasture range birds may need to be protected from animals, birds of prey, and thieves Large turkey growers hire night watchmen who sleep near the range roosts This, of course, is an additional expense On the other hand, a few hundred birds stolen at, or near, marketing age would be a serious loss

The young poults are sometimes started and grown in battery brooders during the first ten days or two weeks of their lives and are then placed in the brooder house or compartment and given access to the attached sun porch until they go on range

Brooder houses A 10 by 12 foot or, preferably, a 12 by 12 foot brooder house or brooder pen with a 12 by 20 foot sun porch attached is enough room for from 125 to 150 poults up to eight or ten weeks of age With fewer birds the brooder house should provide at least 1½ square feet of floor space in side the house and 2 square feet of floor space on the sun porch for each poult Under the confinement system of rearing the sun porch should provide from 5 to 6 square feet of floor space for each bird from the eighth or tenth week to maturity

Although a small colony type house is satisfactory for a relatively small number of poults it is not economical for large numbers Most turkey producers with large flocks prefer the permanent long type house This may be either a single story or a multiple story house and is usually from 24 to 30 feet wide It may be any length depending upon the number of brooder compartments or pens needed Usually there is an aisle 4 feet wide through the center, with brooder compartments on each side and with a door opening from each pen into it In such a house, equipped with a central heating system for additional heat when needed, an electric brooder in each pen, and running water, poults are cared for with a minimum of labor Some long type houses have only one row of brooder pens This type of house may or may not have an aisle along one side but the aisle is preferable, as doors must otherwise be constructed between each pen

Regardless of the type of house used the requirements for good turkey broodiog are uncrowded conditions, comfortable temperatures fresh air without drafts, and sanitary conditions Ventilation is needed to keep the litter dry and to maintain the health of the poults But the fresh air from the outside

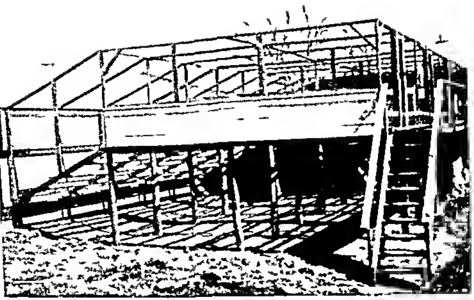
The porches may be enclosed with either slats or wire and covered with light wire netting that is raised high enough above the floor to permit the operator to walk under it without stooping. The fountains and feeders are usually placed around the sides and ends of the porches.

Brooders. For brooding in single colony-type houses or in single brooder compartments, individual brooder units consisting of the hover and heater will be used for each 125 to 150 poults. Coal, gas, or oil-burning brooders are usually preferred for brooding under conditions that make it difficult to keep the room temperature at 60° F. or above. For brooding under conditions where high rather than low room temperatures are problems, electric, gas, or oil burners are preferred in the order named.

For brooding in the permanent long-type brooder house that is usually tightly constructed and often well insulated, a central heating unit to maintain room temperature and electric brooders for spot heating the poults are preferable. This arrangement provides ideal brooder conditions with a minimum of labor to care for the brooders. Regardless of which type of brooder is used, good construction is of the utmost importance.

Feeders. Feeders of various types are used and, as long as they conform to a few essentials, are satisfactory. They must be large enough and must supply enough feeding space to prevent crowding. There should be at least five 3-foot or 4-foot feeders for each brooder unit. They should have reels or guards which will prevent the poults from walking in the feed but which are open enough to encourage eating. Poults do not like to stick their heads through small holes to eat or drink. The feeders should be large enough to supply a day's ration when filled only two-thirds full. With feeders too full, much of the feed is billed out and wasted by the poults. Lips from 1½ to 2 inches wide, fastened to the inside edges of the feeders and tilted toward the center, should be provided after the poults are about four weeks of age.

Fountains. Large waterers are preferable to small ones. Each brooder unit should have two or three 2-gallon fountains with guards that keep the poults out of the water. Large trough-type waterers with float valves to control the supply are ideal after the poults are eight or ten weeks of age and are on



A sun porch with an incline to the house Poults climb from brooder floor level to porch floor level without any trouble The incline and sun porch floor may be constructed of 1 by 4 inch wire or of wood slots

of it should be covered to protect the poults from intense sun and from storms The floor should be high enough above the ground to permit the operator to clean the droppings from under it conveniently The porch may be built large enough to accommodate the poults until they are mature and ready for market. On the other hand, some producers prefer to use a smaller porch for the poults until the eighth or tenth week and then move them to a large one for the remainder of the growing period

One advantage of the large porch is that the brooder house and the small sun porch can be used for other flocks during the year Porches for poults, for the first eight or ten weeks only, may be floored with 1 by 1 inch slats placed 1 inch apart, or with 1 by 2 inch mesh wire on the supporting two by fours Porches designed to support turkeys until market time should be covered with 1 by 1½ inch slats, placed 1½ inches apart, or with 12 gauge 1 by 4-inch mesh electric welded wire Slats are preferable to wire as they are clean and sanitary and are less likely to cause sore feet and breast blisters

Scrub the walls, floors, feeders and fountains with a hot lye solution (one can of concentrated household lye to 30 to 40 gallons of hot water) The lye is used as a cleaning agent and not as a disinfectant When water pressure is available, flush the house out and then permit it to dry thoroughly before disinfecting

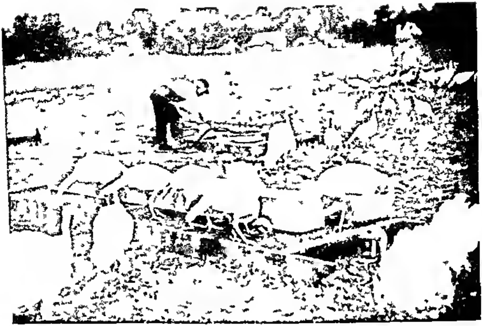
After the house has dried thoroughly so that the cracks in the walls and floor are again open, disinfect it A 5 per cent solution of compound cresol is one of several good disinfectants Use this solution in such quantities that the floor and walls will remain wet for six or seven hours

Open the doors and windows and permit the house to air out and dry thoroughly

After the house has been cleaned, the equipment is installed and all parts of the brooder are checked to see that they are in perfect working order Next, about 2 inches of litter is spread evenly over the entire floor The feeders are arranged around the hover so that they radiate from it like spokes from the hub of a wheel When the room temperature is low (below 60°), the feeders should be extended part way under the hover For the first day or two the fountains are between the feeders where they are readily accessible to the poults at all times The guards encircle the hover at from 1 to 2 feet from its outer edge, depending upon the severity of the weather, the type of brooder used, and whether the guards are wire mesh or solid material They should also be in place at the corners of the brooder house

The brooder heater is started at least a week before the poults arrive and is kept going until the temperature can be under complete control

Brooding temperatures The brooder temperatures should be determined at about 2 inches inside the outer edge of the hover and about 1½ to 2 inches above the litter For the first week, when the room temperature is maintained around 65° to 70° F, a temperature of 90° to 95° F is about right for kerosene or coal burners For electric brooding a temperature of 95° to 100° F is preferred When the room temperature is 50° F or below, the electric brooder temperature should be from 105° to 110° F After the first week, brooder temperatures should be lowered about 5° each week until a temperature of 75° to 80° F is reached Poults seldom need extra



Waterers on wire frames

the sun porch or range When it is practical, running water automatically controlled should be supplied

Guards. Poult guards prevent the birds from wandering away from the heat and getting chilled They are used also to fence off sharp corners in the brooder house or around the feeder to prevent crowding They may be made of wire netting, strips of heavy building paper, roll roofing, or of the regular corrugated cardboard used in chick brooding They should be from 12 to 18 inches high

Time to start the poults. The time to start the poults will depend upon when the birds are to be marketed It will take approximately six months to grow the birds Hence, depending upon the variety selected, turkeys to be ready for the Thanksgiving market need be started about April 15 to May 15

Getting ready for the poults. Preparations should be made for the poults before their arrival All previously used brooding quarters and equipment should be cleaned and disinfected thoroughly

Scrape and sweep the floors and walls and remove all dirt and debris entirely away from the house where it will not be carried back on the operator's feet during muddy weather.

free choice until the birds are ready for market With some systems of feeding, grain is not fed until after the tenth week There is no particular advantage of one system over the other since the rations are adjusted so that the birds are getting the same proportion of the various feed nutrients

Water should be readily available at all times Grit is usually fed once or twice a week but may be kept in separate hoppers before the poults all the time

When weather permits the poults should be encouraged to get out on the sun porch after the first week Feeders and fountains on the sun porch during warm sunny days encourages the poults to spend more time outside

When poults are eight to ten weeks of age they should be placed on a permanent rearing porch or on pasture range They seldom need extra heat from this age to maturity but usually need more feeders, fountains and floor space than most brooder quarters supply By moving them out the brooder quarters and equipment may be cleaned, disinfected, and made ready for starting other groups of poults

Confinement rearing If the poults are to be continued in confinement, they are kept on porches and should have roosts These are usually placed under a roof covered portion of the porch A wire floor is preferred under the roosting section of the porch A low roost, which need be no more than 4 to 6 inches above the floor, is preferred to the high roost Each poult needs 1 foot of roosting space

Automatic watering systems are desirable but provision must be made for cleaning the water troughs or fountains The feeders should be placed where they can be filled conveniently They should be high enough for the poults to eat without stooping, and there should be enough space overhead so that the poults can raise their heads while feeding without moving from the hopper

Picking and cannibalism are likely to occur particularly in confinement rearing Blue backs in the colored varieties are a result of picking Inadequate rations may be a cause, but more frequently it is due to poor rearing conditions One preventive is to avoid overcrowding the flock The birds should also be kept busy Certain feeding practices might help, such as providing fresh green feed and keeping oats in hoppers

A two-compartment brooder house for poults.

heat after the sixth or eight week of brooding. This period may be shortened during warmer weather, however, and may need to be lengthened during the colder season. The poults should be comfortable at all times, and you can tell better whether they are comfortable or not by watching their actions.

Care of poults upon arrival. Put the poults under the hover and then leave them alone for several hours. They will learn to eat and drink quicker and are less likely to start piling up if not disturbed too often while adjusting themselves to their new surroundings. Some growers dip their beaks in water or milk to start them drinking. This may not be essential, but it is often advisable. Observations, if necessary at this time, should be made through the windows or without being seen by the poults. They should learn early to look to the hover, the feeders, and the fountain to satisfy their needs rather than to the caretaker.

Feeding and management of the poults. A turkey starter mash should be fed for the first ten weeks, after which time a turkey grower mash should be used. The mash should be before the birds at all times. A small amount of fine scratch grain may be sprinkled over the mash during the first and second days of brooding, but grain should not become a regular part of the ration until the poults are at least six weeks of age. At that time the scratch grain can be put in separate hoppers and fed

water from fountains or waterers The feeders and waterers should be placed on wire platforms that are on relatively clean ground Contamination of the range should be prevented by moving the feeders and waterers a few feet at least once a week or more frequently if necessary

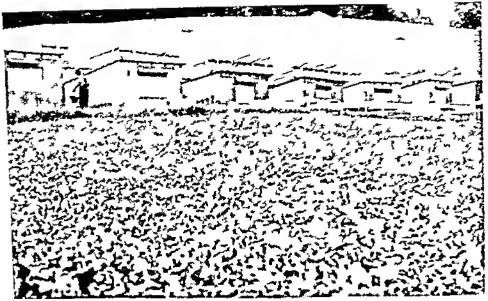
If the range roosts are portable, they should also be moved occasionally This, of course, is not possible in the case of the permanent type of roost If the roosts are not moved, the droppings should be screened from the birds Some kind of shade should also be provided

FINISHING TURKEYS

The poults that have been properly grown on a well balanced ration will usually need little or no extra fattening to get them ready for the market It is more difficult to finish turkeys in warm weather, however If the ration contains a large amount of yellow corn, it will impart a yellow color to the skin and flesh which is a characteristic desired by the market The feeding of moist mashes, milk, and pellets might be beneficial if feed consumption is down Fish meal and particularily fish oil, have been reported as affecting the flavor unfavorably The removal of both fish oil and fish meal from the diet at least eight weeks prior to slaughtering is recommended in order to eliminate the possibility of both fish flavor and odor

MARKETING

The turkeys are either sold alive or dressed on the farm In either case they should be finished A number of factors will determine when the birds have reached the proper condition for market Fleshing or thickness of the meat over the entire body, especially over the breast, keel, and thighs is important Plumpness of the breast is one of the first things for which the consumer looks He also looks for a fattened finish An even covering of yellow fat over the entire body, with no dark or blue flesh between the feather tracts, is desirable Thickness of the skin, determined by taking a fold between the thumb and forefinger, indicates finish There should be no small pinfeathers, especially on the breast or legs The pin feathers should be long enough to come out clean in picking



Rape pasture A Cortland County, New York turkey grower is opening the doors to turn 4 000 young turkeys on this rape pasture It will not be their first taste of rape It has been finely chopped and fed to them since they were two or three weeks of age

before the birds all the time Provide beak wipers, such as fine poultry netting, near the feeders If picking continues the use of antipicking devices or the removal of a portion of the upper beak by cutting or burning may be necessary, but neither removes the cause

Range rearing The success of semiconfinement rearing is dependent upon the correct management of the poults on a good pasture range The care of the pasture is extremely important because the advantage of the pasture is primarily due to the fresh green forage that it supplies Some of the advantages of a good pasture are lower feed costs due to consumption of green food and the possibility of using lower cost rations less danger of a deficient ration because of the supplementation of the green food, and possibly lower mortality and better condition of the birds

The poults should be hardened off before going on range This is done by taking away the extra heat and encouraging the birds to spend most of the time on the porches

The poults should get all of their feed from feeders and all

To prepare the carcass for the oven it needs to be eviscerated The tendons are pulled, and the carcass is preferably trussed

THE BREEDING FLOCK

Keeping mature birds involves further considerations, since the management of turkey breeders and the hatching of poults is a specialized part of turkey production

Housing Houses for turkey breeders do not have to be as warm as poultry houses Breeder turkeys can stand low temperature and still remain healthy Though birds have been wintered in open sheds or even on bare perches in open fields, they should be furnished some protection

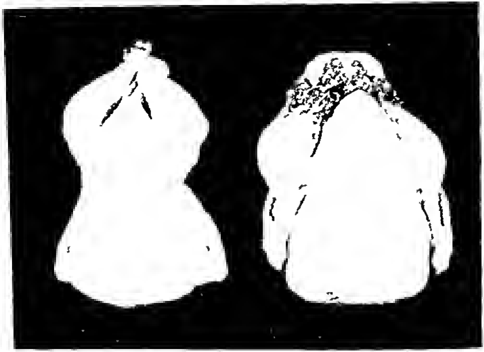
The housing requirements of turkeys are similar to those of chickens, but turkeys need more floor space per bird Fourteen to 15 square feet of floor space for each bird is needed when sun porches or outside runs are available For small flocks the smaller poultry type house can be used For the larger breeding flocks the larger houses are preferred The size of the breeder pens will depend upon the size of the breeding group A 13 by 15 foot breeding compartment will be adequate for a breeding pen of ten or twelve hens and a tom

Equipment Feeders and fountains are needed both inside the house and on the sun porches or runs Enough feeding and watering space must be provided About 50 linear feet of feeder space are needed for 100 breeding turkeys

The amount of fountain space depends somewhat upon the type of fountains used Ordinarily 10 linear feet of fountain space will be needed for 100 turkeys Automatic and temperature-controlled water systems are ideal Both waterers and feeders should be placed on wire platforms

At least one nest is needed in a laying house or yard for each four or five hens The inside dimensions of individual nests should be about 20 to 24 inches high, 12 inches wide and 24 inches deep Turkey trap nests are similar to those used for chickens but must be larger and stronger

Selection of breeders The outstanding turkey hens and toms are kept for breeders The best time for making the selection is about six months of age or the usual marketing time The best type is that which produces meat most efficiently and is of the kind and quality that meets the demands of the market



Finished turkeys, trussed

This is important not only because pinfeathers on the dressed bird are objectionable but also because the more pinfeathers there are, the greater the time to properly pick the bird There should also be a lack of blood in the feather quills

Dressing the bird. The turkey should be starved 12 to 18 hours before slaughtering in order to remove the feed from the crop All handling of the bird should be done carefully since turkey flesh is very easily bruised and sometimes wings or legs may be broken Any of these conditions will lower the market grade

The turkeys are bled and killed in the same way as has been previously described for chickens (Chapter 12)

Four methods of picking are dry, semiscald, hard scald and wax Each method has advantages and disadvantages In deciding which method to use, the amount of labor and equipment required and the quality of the carcass and feathers produced must be considered

After the birds have been picked they should be cooled thoroughly either by exposing them to cool air or immersing them in cold water

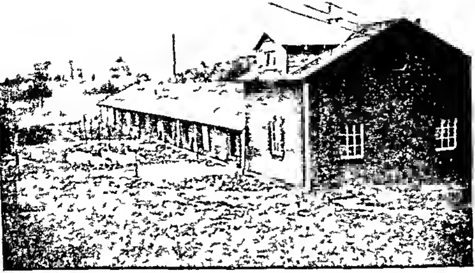
followed will depend upon the number of birds available as well as facilities and time Flock mating may simply mean putting all selected hens and toms together and permitting them to mate indiscriminately and at will Usually not much breed improvement is carried on in this way Improvement in the quality of birds secured from flock mating may be made, however, by following a rigid program of selecting breeding stock and a definite system of flock mating each year, especially if there are more than one flock

Pen mating The mating of one tom with a small number of hens enables one to stay within the blood lines of a particular flock and still breed closely The pen mating system may also be used for progeny testing toms without trap nesting the hens

Trap nesting and progeny testing This is the most rapid, the most accurate, and the best means of breed improvement In this system the hens and the males are individually banded and one male is mated with a pen of hens The hens are trap nested and each egg is numbered The eggs are incubated in pedigree trays and each poult is wing banded to retain its iden tity The offspring from each hen and each tom can then be compared This system of breeding makes it possible to de velop and to locate those families that have the inherent char acters for good body type rapid and economical growth high egg production, high fertility, good viability, and the ability to transmit these characters to their sons and daughters

Management of breeders The males and females are kept in separate quarters until three or four weeks before hatching eggs are desired Then when the pen mating system is used, one tom is usually placed with from ten to twelve hens If the turkeys are mated in large flocks, a somewhat smaller pro portion of toms to hens may be used

If early hatching eggs are desired, artificial lighting may be needed in order to stimulate early laying Since the ovary and oviduct of the female responds more quickly to artificial light ing than the reproductive organs of the male, it appears de sirable to put males under lights one to three weeks earlier than females in order to secure good fertility by the time the females are laying well Prelighting of males is probably not needed when well matured young toms are used to head breed ing units that do not start production before April In that



A long type of breeding house for turkeys. A good house, good feed, and good management are conducive to early egg production and hence early poults

Turkeys selected for breeders should be vigorous and active, be bright and alert of eye, and have smooth, glossy plumage Their bodies should be broad, deep, low set, relatively compact, and well covered with flesh The keel should be moderately long, straight and parallel with the back The breast should be broad, full, and well rounded The legs should be strong, sturdy, set well apart, and not too long The back should be broad and relatively flat

The birds should be selected so as to produce a flock which is uniform as to size, shape, and color of plumage Early maturing and well-developed birds of moderate size are preferred A good size for hens at about six months of age is 12 to 14 pounds and for toms, 20 to 24 pounds

The turkey breeders should conform reasonably well to the standard requirements Do not save for breeding purposes any birds with serious defects and disqualifications of the variety Also do not save birds with deformities or other abnormalities, because they may be inherited These objectionable characteristics include crooked keels, callouses on the keel bone, deformed beaks, crooked toes, deformed feet or backs, and pendulous crops

Systems of breeding The system of breeding that is to be

period, in which case the consumption of grain should be restricted to one full feeding a day in order to encourage mash consumption The mash should be available to the birds at all times The breeder mash should replace the grower mash at least four weeks before hatching eggs are to be saved The proportion of grain to mash that should be consumed will depend upon the make up of the mixture Usually free choice feeding of both mash and grain is practiced At times it might be necessary to resort to wet mash or pellet feeding in order to stimulate food intake or to regulate proportions of grain and mash Oystershells, grit, and clean water should be before the birds at all times

Loss sustained by injury to the breeding hens when extremely large toms are mated with small hens, or from toms that are slow in mating can be minimized by selecting medium sized toms, by trimming the toenails and spurs, and by blanketing the hen at the beginning of the season

Broody hens, which are usually detected by their inclination to sit on the nest at night, should be removed from the nest and placed on bare floors, slatted wires or wire floors The earlier a broody hen is detected and removed from the laying quarters the quicker the broody period is terminated

FEEDING TURKEYS

The feeding of turkeys, especially the young stock, has undergone considerable change in recent years It has followed in the wake of the advances made in chick feeding The nutrients and the ingredients in the ration are the same as for chickens The information gained in the feeding of chickens is being applied quite directly to the feeding of turkeys In fact, many persons are using the regular poultry rations with fairly good success, especially where the turkeys have good range The chicken rations are not generally fed, however, since, in the case of many of the nutrients, the requirements of turkeys differ from those of chickens Turkeys show greater relative gains than chickens, especially in early life These greater gains are reflected in larger demands for some of the nutrients

Nutrient requirements Most recommendations for rations for young turkeys call for a high protein content This, no doubt, is necessary because of the greater rate of growth The

Courtesy Agriculture Department Salinas Evening School Salinas California

A few of the 5,000 turkey poults started in one year by a young California farmer. Turkey raising on a large scale is considered by many to be a hazardous business This young farmer uses knowledge learned in vocational agriculture study to keep his losses to a minimum—and his profits to the maximum

case, males and females may be placed together and lights started at about three weeks before the eggs are to be saved for hatching.

Both toms and hens are usually continued on the grower rations until about four weeks before hatching eggs are wanted Sometimes the birds will consume too much grain during this

TABLE 77. Recommended Nutrient Allowances for Turkeys

Nutrient	Amount per Pound of Feed		
	Starting Poults (0–8 weeks)	Growing Turkeys (8–16 weeks)	Turkey Breeders
Total protein (per cent)	28	20 [1]	15
Vitamins			
Vitamin A activity (I.U.)	4000	4000	4000
Vitamin D (A.O.A.C. units)	600	600	600
Riboflavin (mg.)	2 0	?	1 8
Choline (mg.)	900	?	?
Minerals			
Calcium (per cent)	2 0	2.0	2 25 [2]
Phosphorus (per cent)	1 0 [3]	1 0	0.75
Manganese (mg.)	25	?	15
Salt [4]	0 5	0 5	0 5

[1] May be reduced to 16 per cent after sixteen weeks
[2] May be fed as calcium supplement, free-choice
[3] 0 4 per cent of the total feed should be inorganic phosphorus. Approximately 30 per cent of the phosphorus of vegetable products is nonphytin phosphorus and may be considered as part of the inorganic phosphorus required
[4] Added sodium chloride, may be iodized.

be too bulky, neither should they be ground too coarsely or too finely.

Methods of feeding. Considerable variation exists in the methods of feeding turkeys. These include the feeding of mash only, mash and pellets, scratch grain, or combinations of these. The grains may be hand fed or hopper fed. Most of the trials show no significant difference between the various methods of feeding. In some of the trials, the pelleted feed seems to be more attractive and palatable than mash to young turkey poults.

Representative turkey rations. The following rations are representative of rations that are being recommended and satisfactorily used.

As is the case with poultry rations, it is possible to have a large variety of mixtures for the various kinds of turkeys. Different ingredients differ somewhat for the various sections of the country. The local experiment station or successful turkey raisers in the particular locality should be consulted.

Turkey breeder mashes. The breeding mash requires large amounts of certain of the nutrients, some of which are still in the unidentified class. It is not particularly necessary to have a high energy content, but the indiscriminate use of feedstuffs extremely high in fiber should be avoided.

results to date would indicate that for the most rapid and economical gains, the protein levels of turkey rations should be 24 per cent to 28 per cent for the first six weeks, 20 per cent to 24 per cent for the second six weeks, and 16 per cent to 20 per cent after the twelfth week.

For the growing poult, calcium and phosphorus must be furnished in the largest amounts. With an adequate supply of vitamin D, 0.7 per cent to 1 per cent of phosphorus, and 1 per cent to 1½ per cent of calcium have been found adequate. The ration must have sufficient manganese to prevent perosis. Usually ½ per cent to 1 per cent of salt is added to turkey rations.

The same vitamins are necessary for turkeys as for chickens and are supplied in the same feeds. Special consideration must be given to species' reactions or requirements, however. Turkeys need larger amounts of vitamin A, vitamin D, riboflavin, and choline.

The amount of fiber usually found in turkey mashes is between 4 per cent and 8 per cent. The lower fiber rations are usually higher in energy, which favors more rapid growth.

The Committee on Animal Nutrition of the National Research Council has issued recommended nutrient allowances for turkeys. These allowances shown in Table 77 represent the actual amounts needed to promote normal development and production and take into consideration such factors as variations in the composition of feedstuffs, conditions of storage, methods of feeding, and variations in breed and strain requirements. Hence appropriate margins of safety have been included.

Making up a turkey ration. Most of the common cereals are used in turkey rations. These include corn, wheat, oats, barley, milo, rye. The rations usually contain, also, cereal by products, alfalfa meal, protein concentrates, and vitamin and mineral carriers.

A large number of satisfactory turkey rations have been recommended. The successful ones have shown certain common characteristics. The approximate composition, or general make up, of turkey mashes is shown in Table 78.

The mashes should not be sticky when moistened, because stickiness affects the proper eating of it. They should also not

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Vitamins:			
Vitamin A activity (I.U.)	4000	4000	4000
Vitamin D (A.O.A.C. units)	600	600	600
Riboflavin (mg.)	2.0	?	1.8
Choline (mg.)	900	?	?
Minerals:			
Calcium (per cent)	2.0	2.0	2.25[2]
Phosphorus (per cent)	1.0[3]	1.0	0.75
Manganese (mg.)	25	?	15
Salt[4]	0.5	0.5	0.5

[1] May be reduced to 16 per cent after sixteen weeks.
[2] May be fed as calcium supplement, free-choice.
[3] 0.4 per cent of the total feed should be inorganic phosphorus. Approximately 30 per cent of the phosphorus of vegetable products is nonphytin phosphorus and may be considered as part of the inorganic phosphorus required.
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A large number of satisfactory turkey rations have been recommended The successful ones have shown certain common characteristics The approximate composition, or general make up, of turkey mashes is shown in Table 78

The mashes should not be sticky when moistened, because stickiness affects the proper eating of it. They should also not

Most breeder rations are composed of a mash mixture and a grain mixture. The grain mixtures ordinarily are made up of those grains which are locally available.

Tables 79 to 81 show typical successful turkey-breeding mashes.

TABLE 79. CORNELL TURKEY BREEDER RATION

INGREDIENT	BREEDING MASH (FED WITH GRAIN) [1]
	Per Cent
Yellow corn meal	23
Wheat standard middlings	15
Wheat bran	5
Ground oats	10
Soybean-oil meal	8
Fish meal	7.5
Meat scrap	7 5
Dried skim milk	4
Dried brewers' yeast	3
Dried distillers' solubles	4
Alfalfa meal	7 5
Dicalcium phosphate or steamed bone meal	2 5
Ground limestone	1
Salt	1
Manganese sulfate (feeding grade, 67 per cent $MnSO_4$)	0 04
Riboflavin supplement (to supply)	50 mg/100 lb
D-activated animal sterol	1800 I C U /lb
Total	100 0

[1] To be fed with approximately an equal part of scratch grain, and with free choice oystershell or other calcium supplement.

(Cornell Department of Poultry Husbandry, Extension Stencil 192, revised February, 1951)

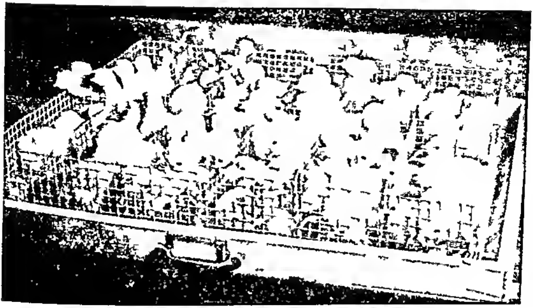
Turkey starter mashes. Recent experiments have shown that most rapid growth and greatest uniformity is promoted by a ration of high available energy content and that with such a ration the turkey poults need a higher protein intake than has been usually recommended. The two characteristics go hand in hand; that is, a high protein level has no advantage except when the ration is high in available energy, and, conversely, the high energy content is most advantageous in the presence of a high protein content. Care should be taken to avoid the use of ingredients very high in fiber, such as light oats, wheat bran, and fibrous alfalfa meal.

Recent research has shown that the turkey poult has a critical need for certain unidentified vitamins. The unidentified

TABLE 78 APPROXIMATE COMPOSITION OF TURKEY MASHES

Ingredient	Starting Mash 0–4 Weeks (All-Mash)	Growing Mashes 4–8 Weeks (All-Mash)	Growing Mashes After 8 Weeks (with Grain)	Breeding Mash (with Grain)
	Per Cent	*Per Cent*	*Per Cent*	*Per Cent*
Yellow corn meal Ground milo Ground or crushed wheat Oat groats Wheat flour middlings	35–40	35–40	40–50	40–50
Wheat standard middlings Wheat bran		10–15	15–20	10–15
Ground oats Ground barley	5–10	5–10	5–10	5–10
Soybean-oil meal[1] Corn-gluten meal Peanut meal	20–30	15–20	10	10
Fish meal[2] Fish solubles Meat scrap (50–55 per cent protein) Liver meal	10–15	10–15	10	10–15
Dried skim milk Dried buttermilk Dried whey Dried brewers' yeast Dried distillers' solubles Fermentation solubles	5–10	5–10	5–10	5–12
Alfalfa meal	2.5–3	5	5–10	5–10
Steamed bone meal Dicalcium phosphate Defluorinated rock phosphate Ground limestone	2	2.5	3	4
Salt	0.5	1	1	1
Manganese sulfate (feeding grade 67 per cent $MnSO_4$)	0.04	0.04	0.04	0.04
Vitamin A and D supplements (to meet required composition)	+	+	+	+
Riboflavin supplement Choline and niacin	(if needed)	(if needed)	(if needed)	(if needed)
Required composition				
Protein (per cent)	28	24	20	20
Calcium (per cent)	1.5	1.5	1.5[3]	[3]
Phosphorus (per cent)	0.9	0.9	1	1.5
Riboflavin (mg/lb.)	2	2	[illegible]	2.7
Vitamin A (units/lb.)	4000	4000	8000[4]	8000[4]
Vitamin D (units/lb.)	600	600	1200	1200
Crude fiber (not over)	5.0	6.5	7.0	7.0

[1] Soybean meal should represent at least three-quarters of the total in this category.
[2] Fish meal and/or fish solubles should represent at least two-thirds of the total in this category for starter and breeder rations.
[3] Free-choice feeding of oystershell or other calcium supplement recommended with these rations no definite calcium content of mash required for breeding mash.
[4] May be reduced to 6900 if scratch grain is 50 per cent corn.



White Holland pedigreed day old poults

expected in the natural feedstuffs used to supply them it is recommended that ingredients from both classes be included in the ration and that more than one ingredient be used from each of the two classes involved wherever possible

Starter mashes are usually fed as an all mash ration for about six to eight weeks, at which time grain is also fed As is the

TABLE 81 TURKEY BREEDER MASH FORMULAS (TO BE FED WITH GRAIN)

INGREDIENT	U S D A	OKLAHOMA	CALIFORNIA
	Pounds	Pound	Pounds
Ground grains			46.5
Yellow corn	26.0	17.0	
Heavy oats		17.0	
Wheat bran	10.0	17.0	15.0
Wheat middlings or shorts	20.0	17.0	
Soybean oil meal		4.0	
Meat scrap	5.0	5.0	
Fish meal	10.0		15.0
Cottonseed meal		7.0	
Alfalfa meal	15.0	10.0	15.0
Dried skim milk or buttermilk	10.0	4.0	
Riboflavin supplement [1]	1.0		
Dried whey			2.5
Limestone or oystershell ground	1.0	1.0	2.0
Steamed bone meal			2.0
Salt	1.0	1.0	1.0
Feeding oil 300 D or equivalent	1.0	1.0	1.0

[1] Containing 225 milligrams of riboflavin per pound

TABLE 80 WASHINGTON TURKEY BREEDER RATIONS

INGREDIENT	RATION 1[1]	RATION 2[2]	RATION 3[2]	PRESEASON MASHES[3] Ration 1	Ration 2
Ground yellow corn	10 0	10 0	17 0	10 0	15 0
Ground oats		10 0	5 0	15 0	15 0
Ground barley	5 0	10 0	10 0		10 0
Millfeed	15 0	15 0	10 0	30 0	20 0
Dehydrated alfalfa	10 0	20 0	20 0	30 0	30 0
Whole wheat	25 0				
Whole oats	15 0				
Dried brewers' yeast	2 0				
Dried whey		3 2			
Soybean-oil meal (44 per cent protein)	7 0	15 0	18 0	3 5	3 5
Meat scrap (55 per cent protein)			6 0		
Fish meal (70 per cent protein)	4 0	8 0		3 0	3 0
Riboflavin concentrate (500 mcg/gm)	0 3	0 5	0 5		
Ground limestone	3 5	3 5	3 0	1 0	1 0
Dicalcium phosphate	2 5	3 5	3 2	1 5	1 5
Fine ground salt (iodized)	0 5	0 8	0 8	1 0	1 0
Feeding oil (2000A 600D/gm) or Vitamin A and D supplement	0 25	0 5	0 5	Note 3	Note 3
$MnSO_4$	Note 1	Note 1	Note 1	Note 2	Note 2

Note 1 Four ounces of manganese sulfate should be added to each ton of diet No. 1 and eight ounces to Diets 2 and 3

Note 2 Eight ounces per ton

Note 3 Add 3½ pounds of activated animal sterols (1500 I C units D per gram) per ton.

Dicalcium phosphate contains 20 6 per cent phosphorus and 26 per cent calcium. If steam bone meal or defluorinated rock phosphate is used in place of dicalcium phosphate, the total phosphorus and total calcium supplied by the calcium and phosphorus supplements should be the same

Bone meal contains approximately 14 per cent phosphorus and 32 per cent calcium Defluorinated phosphate contains 14 per cent phosphorus and 26 per cent calcium

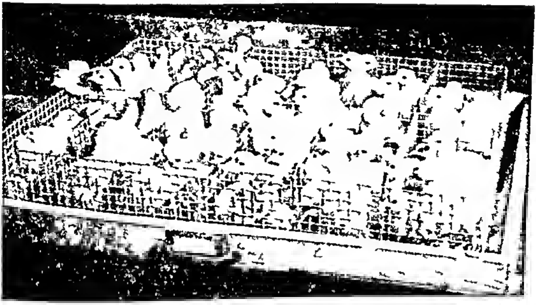
[1] Diet No 1 which is a complete feed should be fed with supplementary shell or limestone grit and hard granite grit

[2] Diets No 2 and 3 should be fed on the basis of 60 parts mash and 40 parts whole grain also, oystershell should be fed free-choice

[3] These mashes are to be fed with an equal amount of grain and free-choice oystershell or limestone grit. A hard grit should be fed once each week

(Poultry Pointers No 39 [Revised], State College of Washington, Pullman, Washington, March, 1949)

nutrients are associated with protein supplements of animal origin and at least one of them is also contained in yeast, distillers solubles, dried whey, and probably fermentation solubles Particular attention must be given to feedstuffs of these two classifications in order to provide sufficient of these unknown factors Because there apparently are at least two factors concerned and because considerable variability can be



White Holland pedigreed day old poults

expected in the natural feedstuffs used to supply them, it is recommended that ingredients from both classes be included in the ration and that more than one ingredient be used from each of the two classes involved wherever possible

Starter mashes are usually fed as an all mash ration for about six to eight weeks, at which time grain is also fed As is the

TABLE 81 Turkey Breeder Mash Formulas (To Be Fed with Grain)

Ingredient	U S D.A.	Oklahoma	California
	Pounds	*Pounds*	*Pounds*
Ground grains			46 5
Yellow corn	26 0	17 0	
Heavy oats		17 0	
Wheat bran	10 0	17 0	15 0
Wheat middlings or shorts	20 0	17 0	
Soybean oil meal		4 0	
Meat scrap	5 0	5 0	
Fish meal	10 0		15 0
Cottonseed meal		7 0	
Alfalfa meal	15 0	10 0	15 0
Dried skim milk or buttermilk	10 0	4 0	
Riboflavin supplement [1]	1 0		
Dried whey			2 5
Limestone or oystershell ground	1 0	1 0	2 0
Steamed bone meal			2 0
Salt	1 0	1 0	1 0
Feeding oil 300 D or equivalent	1 0	1 0	1 0

[1] Containing 2.5 milligrams of riboflavin per pound

case in the feeding of mature birds, the grains usually used are the ones that are available readily locally

Turkey grower mashes All mash rations are sometimes used, especially during the earlier growing period The chief dif-

TABLE 82 CORNELL TURKEY STARTING RATION
(FED AS ALL MASH RATION TO 4 OR 8 WEEKS OF AGE)

INGREDIENT	PER CENT
Ground yellow corn	30
Wheat flour middlings	15
Pulverized heavy oats	5
Soybean-oil meal (low fiber, 50 per cent protein)	23
Fish meal (60 per cent protein)	10
Meat scrap (55 per cent protein)	2 5
Dried skim milk	5
Dried brewers yeast	5
Alfalfa leaf meal (20 per cent protein)	2
Ground limestone	1 5
Iodized salt	0 5
Manganese sulfate (feeding grade, 67 per cent $MnSO_4$)	0 04
Choline	0 05
Niacin	10 gms/ton
High potency vitamin A source	2000 I U /lb
D activated animal sterol	600 I C U /lb
Antibiotic feed supplement	10 gms/ton
Total	100 0

(Cornell Department of Poultry Husbandry, Extension Stencil 192, Revised February, 1951)

ference from starting mashes is the reduced protein content and lower levels of vitamins If the turkeys are to be reared in confinement or if the available range is not in good condition, care must be taken to supply adequate amounts of vitamin A If the birds are reared outdoors, it is not necessary to furnish vitamin D carriers The available energy content of the ration is not so critical as for the starting ration Reasonable amounts of wheat bran and lighter oats can be used, and other cereal grains can replace part of the yellow corn

In most cases both the grain and the mash are hopper fed to growing turkeys

Some growers prefer to feed a concentrate which is similar to the regular growing mash except that it contains larger proportions of the protein concentrates and hence a higher protein content When concentrates are fed, the birds can consume larger proportions of grain

TABLE 83. Washington Turkey Starting Mash Formulas (One to Eight Weeks)[1]

Ingredient	Ration 1	Ration 2	Ration 3	Ration 4
Ground wheat	15.4	14.0	16.0	10.0
Ground yellow corn	15.0	15.2	15.0	14.0
Ground oats	5.0	5.0	5.0	5.0
Mill run	18.0	20.0	19.8	18.0
Fish meal	4.0		2.0	4.0
Meat scrap		5.0	2.5	
Soybean-oil meal (41 per cent protein)	29.0	28.0	28.0	22.5
Ground peas				10.0
Dehydrated alfalfa[2]	7.5	7.5	7.5	7.5
Dried whey				5.0
Fermentation by-product[3] (113,599 micrograms riboflavin per pound)	0.1	0.1	0.5	
Dried brewers' yeast	2.0	2.0		
Limestone flour or ground oystershell	2.1	2.4	2.2	2.1
Bone meal or defluorinated phosphate[4]	1.4	0.3	1.0	1.4
Salt (iodized)	0.5	0.5	0.5	0.5
Fish oil or vitamin-D supplement	Note 1	Note 1	Note 1	Note 1
Manganese sulfate	Note 2	Note 2	Note 2	Note 2
Choline chloride	Note 3	Note 3	Note 3	Note 3
Total	100.0	100.0	100.0	100.0

Suggested analysis	*Per Cent*
Protein	23
Calcium	1.6
Phosphorus	0.8

Note 1 The amount of fish oil or vitamin-D supplement to be added per 100 pounds of turkey starting mashes

Vitamin-D potency A O A C chick units per gram	Vitamin-A potency U S P units per gram	Pounds of supplement per 100 pounds
600	2000	0.2
300	1000	0.4
1500		0.08

Note 2 Add 0.2 of an ounce of manganese sulphate per 100 pounds or 4 ounces per ton of turkey starting mash

Note 3 Add ½ pound of choline chloride per ton of feed If a choline chloride concentrate is obtained, be sure that enough of this concentrate is added to give ½ pound of choline chloride per ton For example, it would take 2 pounds of a 25 per cent choline chloride concentrate

[1] It is often difficult to secure supplies of dehydrated alfalfa meal bone meal defluorinated phosphate, and protein concentrates. If necessary to omit any of these important ingredients, your county agent or poultry specialists at the state college should be consulted, as poorer growth results from omitting necessary ingredients.

[2] When dehydrated alfalfa is not available it is important that turkeys be fed a daily supply of finely cut succulent green feed Sun-cured alfalfa will not replace dehydrated alfalfa, since its protein and vitamin content is much lower

[3] Other riboflavin supplements may be used to supply an equal amount of this vitamin

[4] Dicalcium phosphate may be used as a substitute for bone meal or defluorinated phosphate. The amount would be reduced by about one-third and the limestone or ground oystershell increased by about this amount

(Poultry Pointers No 32, State College of Washington, Pullman, Washington, April, 1947)

TABLE 84 Turkey Starter Mashes

Ingredient	Texas	California	U.S.D.A.
	Pounds	*Pounds*	*Pounds*
Yellow corn, milo or kafir, ground	20.0	15.0	22.5
Heavy oats, ground	15.0		15.0
Wheat, ground	13.5	10.0	
Barley, ground		8.5	
Wheat bran	8.0	15.0	5.0
Wheat middlings or shorts			10.0
Soybean-oil meal	12.0	20.0	24.0
Meat scrap			5.0
Fish meal	14.0	12.0	5.0
Alfalfa meal	8.0	10.0	8.0
Dried skim milk	5.0		
Dried whey		4.0	
Fermentation by product			1.0
Limestone or oystershell, ground	1.5	2.0	2.0
Steamed bone meal	2.5	1.0	
Salt	0.25	1.0	1.0
Feeding oil, 300 D or equivalent	0.5	0.5	0.5
Granite grit			1.0
Cane molasses		1.0	

TABLE 85 Cornell Turkey Growing Mashes

Ingredient	Growing Mash 4–8 Weeks (All-Mash)	Growing Mash After 8 Weeks (with Grain)[1]
	Per Cent	*Per Cent*
Ground yellow corn	22.0	30.0
Wheat standard middlings	20.0	20.0
Pulverized oats	10.0	10.0
Soybean-oil meal	21.0	10.0
Fish meal	5.0	
Meat scrap	5.0	10.0
Dried brewers' yeast	4.0	4.0
Dried distillers' solubles	5.0	5.0
Alfalfa leaf meal	5.0	7.0
Ground limestone	1.0	1.0
Steamed bone meal	1.5	2.0
Iodized salt	0.5	1.0
Manganese sulfate (feeding grade, 67 per cent $MnSO_4$)	0.04	0.04
D activated animal sterol	600 I.C.U./lb	1200 I.C.U./lb
Total	100.0	100.0

[1] Scratch grains may be fed free-choice starting at 12 weeks.

(Cornell Department of Poultry Husbandry, Extension Stencil 192, revised February, 1951.)

TABLE 86. WASHINGTON TURKEY DEVELOPING MASH FORMULAS (NINE WEEKS TO MATURITY)[1]

INGREDIENT	RATION 1	RATION 2	RATION 3	RATION 4
	Per Cent	*Per Cent*	*Per Cent*	*Per Cent*
Ground wheat	10.0	8.0	9.0	8.3
Ground yellow corn	10.0	10.0	9.0	14.0
Ground oats	10.0	10.0	5.0	5.0
Ground barley	5.0	9.0	7.0	
Mill run	17.0	17.0	15.0	17.0
Fish meal	3.5		1.5	
Meat scrap		4.5	2.5	
Soybean-oil meal (41 per cent protein)	16.0	14.0	13.0	22.0
Ground peas			10.0	
Dehydrated alfalfa or high-quality alfalfa meal[2]	20.0	20.0	20.0	20.0
Dried whey				5.0
Limestone flour or ground oystershell	0.8	0.8	0.7	0.8
Bone meal or defluorinated phosphate[3]	6.7	5.7	6.3	6.9
Salt (iodized)	1.0	1.0	1.0	1.0
Manganese sulfate	Note 1	Note 1	Note 1	Note 1
Fish oil or vitamin-D supplement	Note 2	Note 2	Note 2	Note 2
Total	100.0	100.0	100.0	100.0

Suggested analysis	*Per Cent*
Protein	20
Calcium	2.4
Phosphorus	1.5

Note 1 Add 0.4 of an ounce of manganese sulfate per 100 pounds or 8 ounces per ton of developer mash

Note 2 It is not necessary to add a vitamin D supplement to the developing ration if turkeys are on green range If turkeys are raised in dry lot or in confinement without being supplied with chopped green feed, add 0.6 pound (2000 units of A per gram fish oil) per 100 pounds of mash

[1] It is often difficult to secure adequate supplies of alfalfa meal, bone meal defluorinated phosphate, and protein concentrates. If necessary to omit any of these important ingredients your county agent or poultry specialists at the state college should be consulted as poorer growth results from omitting necessary ingredients.

[2] When dehydrated alfalfa is not available it is important the turkeys be grown on a good green range

[3] Dicalcium phosphate may be used as a substitute for bone meal or defluorinated phosphate. The amount would be reduced by about one-third and the limestone or ground oystershell increased by about this amount.

(Poultry Pointers No. 32, State College of Washington, Pullman, Washington, April, 1947.)

Feed required by turkeys About 40 pounds of mash and 20 pounds of grain are required to produce a 15 pound turkey at 24 weeks of age under the complete-confinement method of rearing When turkeys are confined, they will consume somewhat more total feed and also require more pounds of feed to

TABLE 87 Turkey Grower Mashes

Ingredient	U.S D.A.	California	Oklahoma
	Pounds	*Pounds*	*Pounds*
Yellow corn, ground	28 0	10 0	17 0
Heavy oats, ground			17 0
Wheat, ground		10 0	
Barley, ground		23 0	
Wheat bran	6 0	15 0	17 0
Wheat middlings	15 0		17 0
Soybean-oil meal	15 0		6 0
Meat scrap	5 0	15 0	9 0
Fish meal	6 0	8 0	
Cottonseed meal			6 0
Alfalfa meal	15 0	10 0	9 0
Riboflavin concentrate [1]	1 0		
Dried whey		3 0	
Limestone or oystershell, ground	2 0	2 0	1.5
Steamed bone meal	6 0	2 0	
Salt	1 0	1 0	0 5
Cane molasses		1 0	

[1] Containing 225 milligrams of riboflavin per pound.

produce a pound of gain than when they are allowed to range

More pounds of feed are required to produce a pound of gain as the poults grow older This is shown in the following figures giving the amount of grain and mash fed per pound of gain in weight

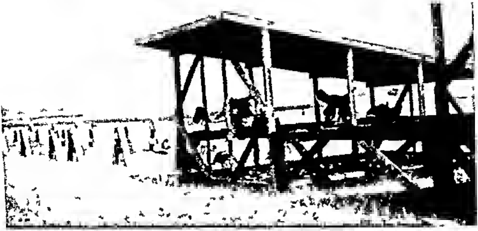
Age in Weeks	*Pound of Feed per Pound of Gain*
1–4	2 06
5–8	2 53
9–12	3 08
13–16	3 50
17–20	4 52
21–24	6 92
1–24	4 12

Most of the experimental results show fair agreement in the utilization of feed by growing turkeys The pounds of feed required to produce a pound of gain up to 24 weeks of age as recorded by a number of stations is as follows

Station	*Pounds of Feed Required to Produce a Pound of Gain*
Pennsylvania	
Bronze	4 49
White Holland	4 73
U S D A	4 12
Oklahoma	
Bronze	3 82
	4 12
	4 45
South Carolina	
Broad-Breasted Bronze	4 00
	4 37
Small type Broad-Breasted White	4 39
	4 53
Indiana	
Bourbon Red	3 35
	3 51
Massachusetts	
Bronze	4 41
White Holland	4 85
Cornell (New York)	
White Holland	4 19
	4 37
	3 91

The feed consumption of young Bronze breeding hens fed as desired has been reported to average 3 23 pounds per week per hen for the 8 week winter period 2 73 pounds per week for the 16 week spring period, and 3 50 pounds per week for the 4-week fall fattening period, after having been held on limited maintenance rations of 1 40 pounds of scratch grain per hen per week during the summer period of 20 weeks For the 48 week year, the total feed consumed was 111 52 pounds By adding four weeks to the summer maintenance period, the total was 117 12 pounds for the full year of 52 weeks The males ate nearly twice as much feed per average bird as the female The requirement for the 48 week year being 226 88 pounds and for the 52 week year 210 88 pounds

The amount of feed consumed monthly will depend upon the size of the breeding hens Broad Breasted Bronze have



Open and covered range roosts for turkeys

been reported as consuming about 18 pounds of feed per month, Standard Bronze, 17 pounds, White Hollands, 15 pounds, and Beltsville Whites, 12 pounds

In an economic study of Washington's turkey breeding flocks, it was found that the total amount of feed, excluding shell, fed by growers in different parts of the state did not vary much For 61 farms it averaged 31 2 pounds of mash, 1 2 pounds of hay, and 40 3 pounds of grain, or a total of 72 7 pounds

LOSSES IN TURKEY PRODUCTION

The turkey producer must be at all times on the lookout to reduce losses Most of the losses are the result of disease, although there are other reasons also for mortality

Prevention of disease. Prevention of disease rather than the cure should be the aim In this connection, the old proverb is particularly applicable, namely that "Cleanliness is next to Godliness " By this is meant cleanliness in every department, such as clean stock, clean houses, clean brooders, clean ranges, clean feed, and clean management in all of its phases

Sanitation. Thorough cleaning of the houses and equipment is essential Disinfection and fumigation will help to get things clean Approved disinfectants, such as creosol solutions, should be used frequently Litter and dead birds should be disposed of in such a way that there is no danger of their coming in contact with the stock

Vaccination. Vaccination will help to reduce losses in the case of some of the diseases where reliable vaccine has been developed, as, for example, cholera, pox, and typhoid

Medication. In many diseases, medication is of relatively little value It can be used effectively, however, in the treatment of parasites These would include lice, mites, worms, and coccidiosis Other conditions, such as sinusitis and bumble foot, also submit to treatment

Epidemics. The good turkey grower is ever on the alert to detect abnormal conditions By recognizing a disease in its earliest appearance, frequently epidemics and large losses can be avoided An autopsy should be performed at once in order to find out the nature of the disease so that the proper methods of treatment can be applied The autopsy also should be made by a competent person, such as a veterinarian, pathologist, or bacteriologist In most states the diseased birds can be taken to a public diagnostic laboratory Some of the larger feed companies also maintain diagnostic laboratories for this service In selecting birds to be diagnosed, be sure that the specimens are representative of the common, or general, condition

Keeping losses at a minimum by good management. Losses can be kept to a minimum, and hence profits can be increased, by good management practices Keep the adult turkeys away from the poults It is particularly important to keep the turkeys away from chickens

Early poults generally do better than those hatched later in the season

Start pullorum free poults in houses and with equipment that has been thoroughly cleaned Watch out for crowding and piling Prevent contamination by continued cleanliness, keeping in mind the fact that most diseases are filth borne

The establishment of quarantine measures will help to reduce mortality The strictness of such measures will be governed more or less by circumstances In this category should be included the introduction of stock and eggs from outside sources, the admission of visitors to the farm, the transportation of feed in containers that have been off the farm, the use of equipment, such as coops and crates, that have had other birds in them and which have been on the outside, and the movement of animals or other wildlife which might act as carriers

Sometimes losses are due to flying or stampeding, usually caused by sudden fright In some localities, protection against wind and snow must be given late in the season

Losses All turkey growers expect to suffer some losses, but the objective is to keep these at a minimum Great variation exists in the percentage losses on different farms In the case of adult birds, this should not exceed 10 per cent On some farms the loss is practically nil

In the case of the young stock, losses of 25 per cent are not uncommon In epidemics this figure will be exceeded considerably It is encouraging, however, that on some farms the loss is less than 10 per cent Large losses need not be anticipated if correct practices are followed

Parasites The most common external parasites are lice and mites The most common internal parasites are tapeworms and roundworms Cecal worms might also be important because of the part they play in the transmission of blackhead

For further information and treatment regarding parasites see Chapter 14

Protozoan diseases Protozoa are minute, one-celled parasites which gain access to the body and produce disease When the flock becomes heavily infected the mortality is likely to be very high Prevention is the best means of protection, and, therefore, everything should be done to keep these organisms from entering the flock The most common protozoan diseases in turkeys are coccidiosis and blackhead

Coccidiosis Coccidiosis is caused by coccidia which are minute, miscroscopic protozoa that live in the cells that line the intestine The parasites destroy these cells and cause inflammation Birds affected with coccidiosis discharge large numbers of the parasite in their droppings These in turn, under proper conditions, can affect other animals General symptoms include listlessness ruffled feathers drooping wings and diarrhea Sometimes the droppings are bloodstained

Cecal, or acute, coccidiosis usually occurs in the younger birds The ceca are distended and filled with blood The intestinal or chronic coccidiosis usually affects older birds In this case, the birds show a thickened and inflammed condition of the intestines

Prevention is most effective in controlling coccidiosis Keep

the young stock away from the old birds Keep the houses and surroundings clean and dry

Satisfactory treatment has been reported with the use of sulfur and sulfa drugs

Blackhead Blackhead is the disease which caused fluctuation in the production of turkeys until the nature of the disease and its relation to blackhead in chickens became established It was called blackhead because of the darkened head which resulted from the infection Characteristic symptoms are weakness, droopiness, ruffled feathers, and yellow droppings The organs principally affected are the ceca and liver The ceca become swollen and ulcerated The liver is covered with white or yellow areas

Prevention is more important than treatment A proper sanitation program will control the disease Phenothiazine has been reported as a possible remedy for it, since it controls the cecal worm which acts as an intermediate host. Enheptin has also been reported of value

Bacterial diseases. The common bacterial diseases are pullorum, typhoid, and cholera For details of these diseases, see Chapter 14

Virus diseases. A common virus disease is fowl pox This is a virus disease which may occur in the birds at any age, with the exception of the very young poult It is characterized by small, yellowish eruptions on the head and yellow cankers in the mouth As the disease develops, the lesions on the head enlarge and have the appearance of dried scabs The disease can be controlled by vaccination

Nutritional diseases A deficiency of some of the nutrients, particularly vitamins, will produce the so-called nutrition deficiency diseases The ones that are likely to occur are rickets due to a lack of vitamin D, nutritional paralysis due to a lack of riboflavin, and dermatitis caused by a deficiency of pantothenic acid or biotin Perosis is usually due to a deficiency of manganese and choline Leg weakness and poor bone development might be the result of an insufficiency of phosphorus and calcium as well as vitamin D

Losses due to other conditions *Pendulous crop,* a condition also known as baggy crop or impacted crop, might be due to the overconsumption of liquid or a mechanical obstruction caused

by the consumption of large amounts of coarse feed This causes the crop to become distended Treatment is not practical It has been observed that the tendency to develop pendulous crop seems to be *inherited* In that case, selection of families without this tendency would be helpful in eliminating it from the flock

Leg trouble or hock trouble This condition has caused trouble in some flocks It results in a swollen hock resembling in some respects birds afflicted with perosis In some instances a bacterial infection accompanies it The cause for this condition is not known and, hence, no treatment can be recommended It is believed, however, to have a nutritional basis The use of fish liver oil has been reported to aggravate its incidence Also dried brewer s yeast seems to help prevent it

Disease diagnosis If the birds are not growing or producing as they should or if losses other than accidental are occurring, a pathologist should be consulted in order to eliminate the possibility of disease The outward appearance and actions of the birds might give some indications, but it is usually necessary to make a post mortem examination to definitely determine the cause of mortality This requires observation, tests, and interpretation by a trained person

The outward symptoms are helpful, but frequently, by the time they have developed to this stage, the condition is quite serious Some of these indications are as follows

General inactivity, weakness and listlessness, although more or less common to all disease conditions, are more general in the case of pullorum, typhoid, and paratyphoid as well as coccidiosis and worm infestation

Diarrhea is usually characteristic of pullorum, typhoid, paratyphoid, coccidiosis, blackhead, and cholera In acute coccidiosis the droppings may be bloody In the case of blackhead and cholera, they are usually yellowish in color

Loss of appetite generally accompanies an outbreak of cholera and various conditions of enteritis

Yellowish eruptions and scabs on the head denote fowl pox. A swollen snood is characteristic of erysipelas

A distended crop denotes pendulous crop

Swollen feet or legs usually denote an infection of some type

The call of the wild.

Leg weakness ordinarily indicates nutritional difficulty, especially a lack of vitamin D and calcium or phosphorus.

SUGGESTIONS AND QUESTIONS

1. Compare the commercial turkey rations offered for sale in your locality with respect to price, guaranteed analyses, and ingredients.
2. Make a survey of turkey production in your area. Is the number of turkeys produced increasing or decreasing? Try to determine the reasons for this
3. To what extent are turkeys being reared in confinement? How do these farms compare with those raising turkeys on range?
4. Formulate a turkey starting ration from feeds available in your market. Compute the nutrients to be sure the recommended allowances are met.
5. Do the same for a turkey growing ration.
6. Do the same for a turkey breeder ration.
7. Keep records on a flock of turkeys to be able to compute average weights, feed per bird, and feed necessary to produce a pound of gain.
8. What are the causes for losses in turkey flocks?
9. What diseases have been reported in your locality during the past year?

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Agricultural Experiment Stations

State	*Location of Station*	*State*	*Location of Station*
Alabama	Auburn	Nevada	Reno
Arizona	Tucson	New Hampshire	Durham
Arkansas	Fayetteville	New Jersey	New Brunswick
California	Berkeley and Davis	New Mexico	State College
Colorado	Fort Collins	New York	Geneva and Ithaca
Connecticut	Storrs	North Carolina	Raleigh
Delaware	Newark	North Dakota	Fargo
Florida	Gainesville	Ohio	Wooster and Columbus
Georgia	Athens	Oklahoma	Stillwater
Idaho	Moscow	Oregon	Corvallis
Illinois	Urbana	Pennsylvania	State College
Indiana	Lafayette	Rhode Island	Kingston
Iowa	Ames	South Carolina	Clemson
Kansas	Manhattan	South Dakota	Brookings
Kentucky	Lexington	Tennessee	Knoxville
Louisiana	Baton Rouge	Texas	College Station
Maine	Orono	Utah	Logan
Maryland	College Park	Vermont	Burlington
Massachusetts	Amherst	Virginia	Blacksburg
Michigan	East Lansing	Washington	Pullman and Puyallup
Minnesota	University Farm, St Paul	West Virginia	Morgantown
Mississippi	State College	Wisconsin	Madison
Missouri	Columbia	Wyoming	Laramie
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